HEATING AND VENTILATING

AUGUST 1930

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OF AGRI. AND APP. SCIENCE

ILLINOIS HEATING SYSTEMS

Selected from among ILLINOIS installations within one year, in Chicago alone, these eight buildings typify the varying conditions and exacting operative requirements that are being met with ILLINOIS Heating Systems, to the entire satisfaction of architects, engineers, contractors and owners.

When millions of dollars are invested in projects such as these, it is done carefully; wisely. ILLINOIS is specified for the heating, for client satisfaction must be assured.

Write for Bulletin 22

1. Merchandise Mart
   "The World's Largest Building"
   Marshall Field & Co., Owners
   Graham, Anderson, Probst & White, Architects
   Robert Gordon, Inc., Heating Contractors
2. The Chicago Daily News Building
   Holabird & Root, Architects
   J. A. Sutherland, Engineer
   Robert Gordon, Inc., Heating Contractors
3. Steuben Club
   K. M. Vitzthum & Co., Inc., Architects
   E. B. Kaiser, Heating Contractors
   E. S. Volk, Engineer
4. The Foreman National Bank Building
   Graham, Anderson, Probst & White, Architects
   Phillips Getschow Co., Heating Contractors
5. *One La Salle Street
   K. M. Vitzthum & Co., Inc., Architects
   John D. Small, Engineer
   Mehring & Hanson Co., Heating Contractors
6. Willoughby Tower
   S. N. Crowen & Associates, Inc., Architects
   Kohlbry-Howlett Co., Heating Contractors
   A. W. Nelson, Engineer
7. Board of Trade
   Holabird & Root, Architects
   J. A. Sutherland, Engineer
   Mehring & Hanson Co., Heating Contractors
8. *Buckingham Building
   Holabird & Root, Architects
   J. A. Sutherland, Engineer
   Kohlbry-Howlett Co., Heating Contractors

*Illinois Zone Control Systems.

ILLINOIS ENGINEERING COMPANY
ROBT. L. GIFFORD. PRES. INCORPORATED 1900
BRANCHES AND REPRESENTATIVES IN 40 CITIES
CHICAGO

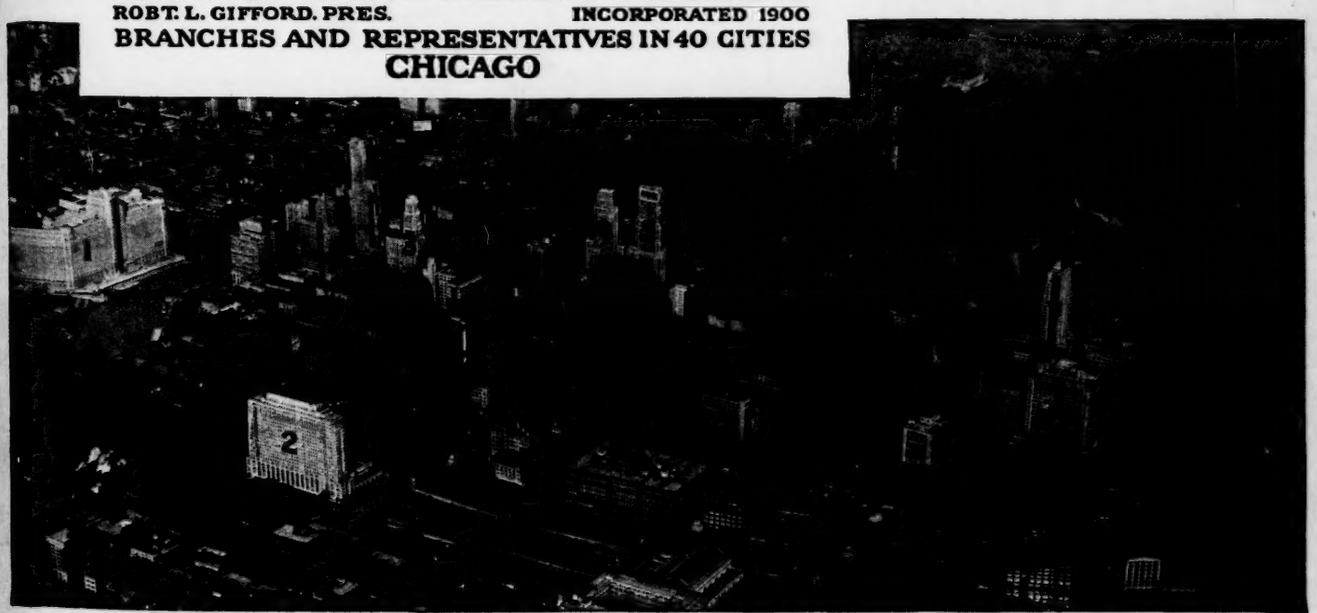


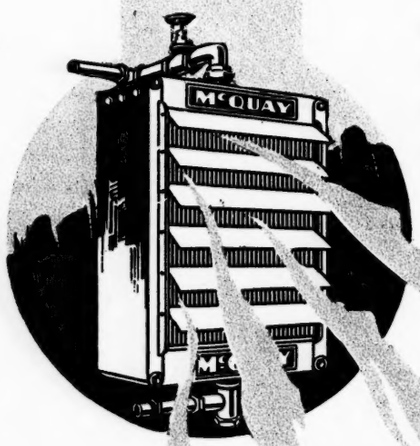
Photo by Chicago Aerial Survey

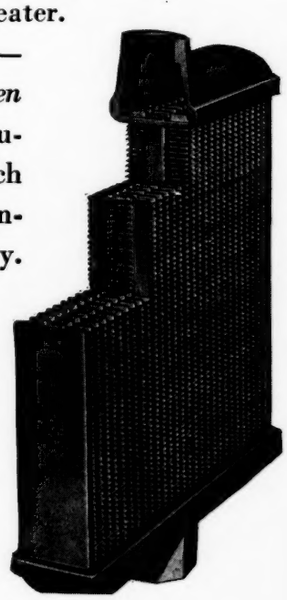
BETTER *in 4 ways*

One of the Pioneers in the manufacturing of *copper* radiators for Industrial as well as Automotive uses, McQuay Unit Heaters are the result of many years experience. *Actually they are without "bugs."*

All the weaknesses of many early types of heaters have been completely eliminated—so that today's installation of McQuays insures unfailing, repair-free heating service, plus all the well recognized advantages of this type of heater.

In factories, warehouses, garages—*wherever a tough heating problem has been met*—unit heaters have provided the solution. So it is only a question of which make. The features enumerated below indicate the advisability of selecting McQuay.





Sectional view showing the sturdiness of the McQuay All Copper, Totally Welded Heating Element.

The heating element is suspended in its cast frame so that contraction and expansion strains in the frame are not carried to the heating element—the cause of most leakage trouble in some types of heaters.

The motor rests in a cork insulated saddle which absorbs vibration and prevents rattling. The McQuay is very quiet.

Seamless copper tubes welded into heavy copper headers *provide equal expansion and contraction*, eliminating chance of leaks that occur when tubes and headers are of different materials.

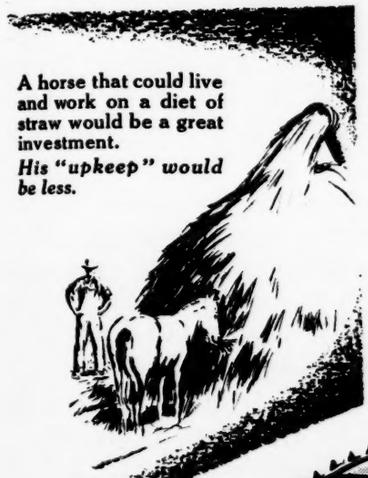
The *all copper* heating element increases heat conductivity and prevents corrosion. Factory tested with 300 lbs. hydrostatic and 125 pounds steam pressure, it is the most rugged unit built.

Also: A complete line of Cabinet and Concealed Radiators for heating Homes, Apartments, Hotels, Hospitals, etc.
WRITE FOR SEPARATE BULLETINS.

McQUAY UNIT HEATERS

McQUAY RADIATOR CORPORATION General Sales Offices: 35 East Wacker Drive CHICAGO

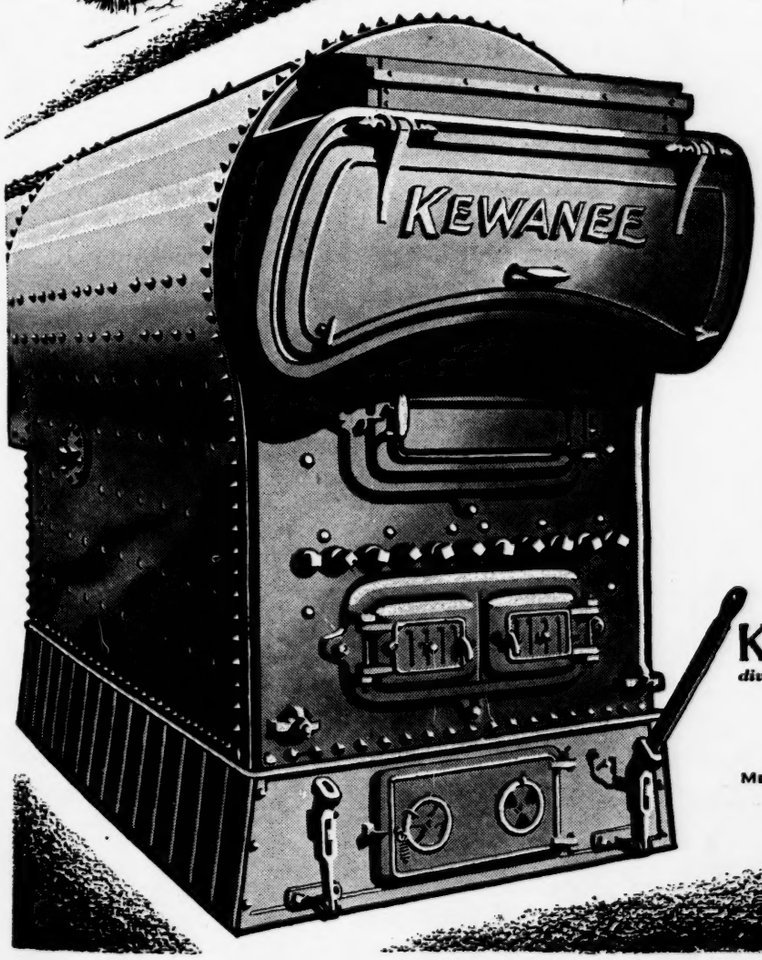
KEWANEE STEEL BOILERS



A horse that could live and work on a diet of straw would be a great investment. *His "upkeep" would be less.*

Because they are designed to burn the cheaper grades of soft coal, *and extract all the useable heat from it,* Kewanee Smokeless (Down-Draft) Boilers greatly reduce "up-keep" costs.

On top of that their steel riveted construction is sufficiently strong to add many *extra years of service* to their life—making them in fact the best boiler investment in the world.



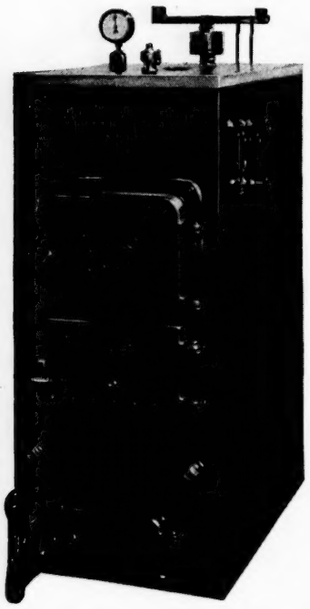
Now there's a Kewanee Steel Boiler to heat every size building. Ask about Type "R" for Homes and Smaller Buildings.

KEWANEE BOILER CORPORATION
division of American Radiator & Standard Sanitary Corporation
KEWANEE, ILLINOIS
Branches in Principal Cities

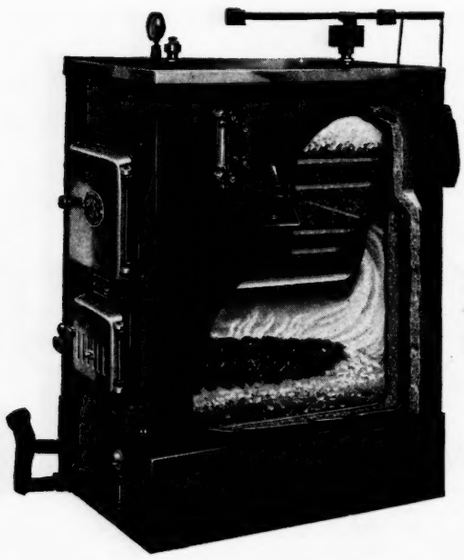
MEMBER OF STEEL HEATING BOILER INSTITUTE

It Costs Less to OWN a KEWANEE

Skyscraper efficiency in home heating



Pacific RED CREST



GREAT modern skyscraper buildings brought new and far more exacting requirements for heating engineers to solve. Tenants demanded ideal comfort. Profit margins called for strictest economy. Failure or waste in heating simply could not be tolerated.

To completely meet these demands, Pacific Welded Steel Boilers were developed. Always dependable, supplying heat always adequate, at the lowest cost for fuel, they have proved their merit in hundreds of the largest and finest buildings in America.

Now, the same high efficiency at low cost is offered to homes by the new Pacific *Red Crest.* In it is found the durable welded steel construction, the scientific heat engineering, that has given leadership to Pacific boilers for larger buildings.

Added to these is the beauty of a handsome jacket of red and blue enamel on steel, a fuel saving blanket of thick rock wool insulation, and the compactness required in a home heating boiler.

Here, in brief, is a boiler that brings skyscraper efficiency to home heating.

PACIFIC STEEL BOILER CORPORATION
General Offices: Detroit, Michigan
Factories: Waukegan, Ill.; Bristol, Pa.
Sales Offices in 58 Cities
Division of the United States Radiator Corp., Detroit, Mich.

Pacific Boilers and PACIFIC *Capitol Radiators*
make a logical combination

PACIFIC
STEEL HEATING BOILERS

HEATING AND VENTILATING, *formerly* THE HEATING AND VENTILATING MAGAZINE, published by BUILDING DIVISION of NATIONAL TRADE JOURNALS, INC., 521 Fifth Ave., New York, N. Y. Subscription rates: United States, $2.00; Canada, $2.50; Foreign, $3.00. Single Copies, 30 cents. Vol. XXVII, No. 8, August, 1930. Entered as second-class matter, April 18, 1925, at the Post Office at New York, N. Y., under the Act of March 3, 1879. Copyright 1930, by NATIONAL TRADE JOURNALS, INC.

«Let's Build a Boiler like an Automobile Radiator»

. . . Said H. M. Jerome

The late H. M. Jerome, Automotive Engineer, scientist, and inventor.

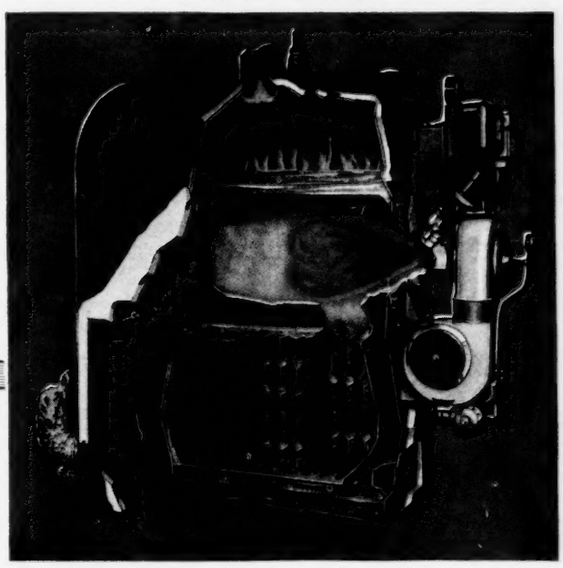
WHY should a man noted for his successes in the field of automotive engineering concern himself with boilers for home heating? When a really scientific problem presents itself, a true inventor, once interested, cannot rest until it is solved. And Inventor Jerome was determined. He would perfect *an automatic heat machine that would deliver heat at low cost.*

The cooling system of an automobile engine and a house heating plant are much alike . . . both transfer heat. In an automobile motor the tremendous heat developed in the combustion chamber must be carried away. Water around the chamber absorbs the heat . . . passes it through the great number of small passageways in the radiator, which is exposed to the cool air, . . . and the heat from the water is radiated into the open air.

«Why not build a boiler like an automobile radiator,» reasoned Mr. Jerome. But, instead of exposing the «radiator» to the air and allowing it to throw off heat . . . expose it to the hot gases of combustion (from fuel oil or gas) and make it *absorb* the heat and pass it on into the heating system.

The high velocity flow, through the very irregular water and air passages of an automobile radiator, produces a turbulence that washes off the film of air, which by adhering to the metal reduces conductivity. The result is a greatly increased heat transfer. In the Gar-Wood, the combustion chamber is placed at the *top* of the boiler and well over one-half the fuel's radiant heat is absorbed by the water immediately surrounding the chamber. The remaining hot gases pass down into the narrow openings between a series of flat water tubes, which are baffled in such a way as to cause a scrubbing action of the hot gases against the steel walls of the tubes.★ The result is an almost complete transfer of the remaining heat into the water sections. Stack temperatures are held just high enough to prevent condensation.

★ The short, wide flues of the old type boiler are not built to absorb the intense heat produced by an oil burner.



Complete details of this most efficient and more economical balanced heating unit are to be found in our new book. The coupon brings it.

Gar Wood Engineering Co.
4196 Bellevue Ave., Detroit, Mich.

Gentlemen: Send me . . . *without cost or obligation* . . . a copy of "A New Principle of Generating Heat at Low Cost."

Firm Name _____

Address _____

City _____

State _____

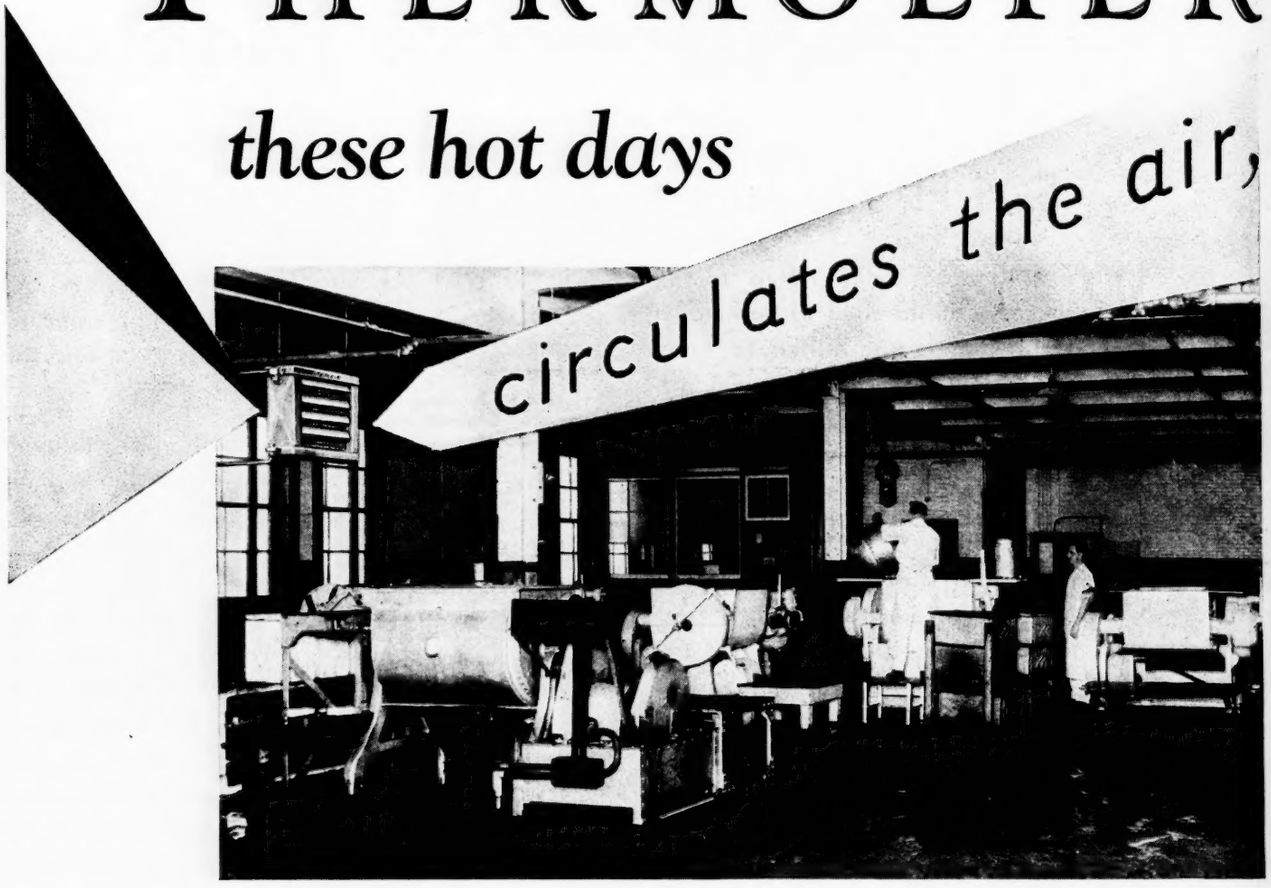
Requested by _____

GAR WOOD ENGINEERING CO.
4196 Bellevue Ave. Detroit, Michigan

Gar-Wood

THERMOLIER

these hot days

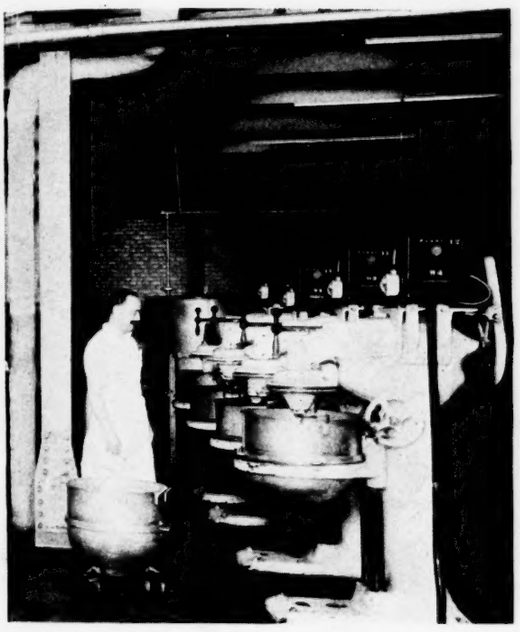


THIS is the time to modernize your unsatisfactory heating system. When the temperature drops next winter you'll never again think about whether it is warm or cold. When you have Thermoliers no one will even be conscious that there *is* a heating system. They diffuse warmth from above, and the warmth is automatically controlled.

Cold spots are abolished. A stream of live air prevents pockets of dead air.

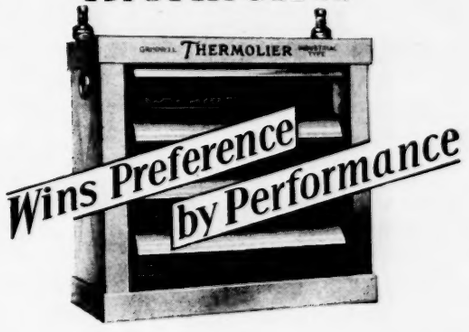
The cost is reduced and the piping simplified, because each unit has an internal cooling leg drained by a close-up Thermoflex trap.

blowing a freshening breeze down



How it circulates the air! With no steam on, its powerful fan drives a freshening breeze down, vitalizing the workmen.

Thermolier



Made in eight models to fit any space and every condition

Many Thousands of Units in Use

Our heating experts have doubtless already solved conditions paralleling yours. Why not get their advice, or write for the booklet on heating called "Fourteen Points of Superiority"? There is no obligation on your part. The coupon is for your convenience.

GRINNELL COMPANY

Executive Offices: Providence, R. I.

Branches in all Principal Cities

14 Points of Superiority

GRINNELL COMPANY, INC.
208 W. Exchange St., Providence, R. I.

I want to read more facts about the Thermolier. Send along the booklet.

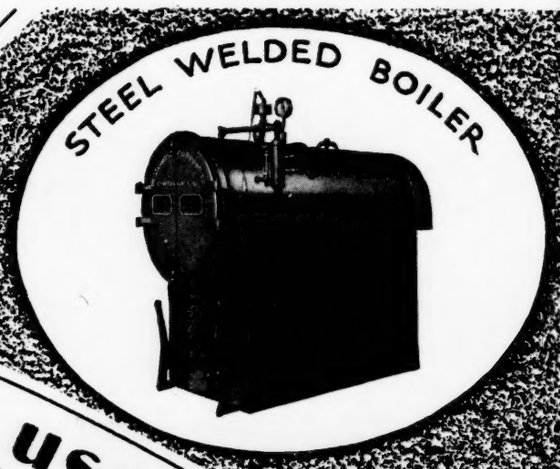
Name_____

Title_____

Firm Name_____

Address_____

there are hundreds of uses for STANWOOD BOILERS

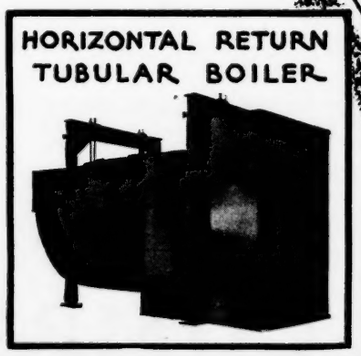


Your chances for installation are far greater than you possibly realize.

For instance, the Steel Welded Heating Boiler—Smokeless or Direct Draft—is compact and requires the minimum amount of space. It is built for 15 lbs. pressure and suitable for any size heating job —large or small.

Then, the Steel Riveted Smokeless Boiler is designed to squat close to the floor—ideal for shallow basements and places where excavation is out of the question. The water line is only 48″ to 75″ from the floor, depending on size. It is built for heating and power—15, 100, 125, and 150 lbs. pressure—and is suitable for any small or large building—apartment, office, school or industrial.

And, finally, the Horizontal Return Tubular Boiler rounds out the line. When installed in a Stanwood Bag Type Steel Casing (as pictured) maintenance costs are reduced and air leakages eliminated. It is also furnished for box or brick settings—pressures 100, 125, and 150 lbs.—power or heating—suitable for most any type of service.

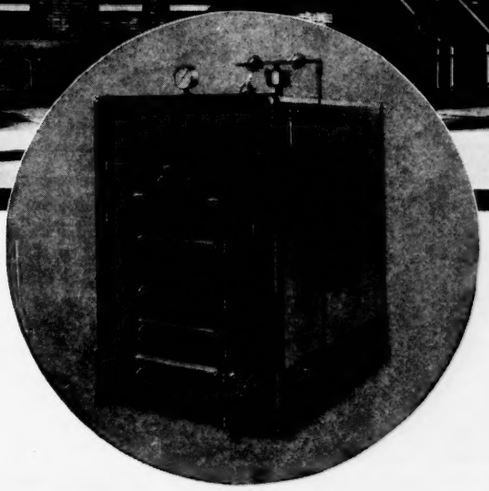


Write for the complete set of bulletins today; be prepared to specify STANWOOD on your next job. — Welded Boiler No. 100—Steel Riveted Boiler No. 500—HRT Boiler No. 517. Dept. D-830.

The STANWOOD CORPORATION, *Cin'ti, O.*

The HEATING CONTRACTOR Modernized this Apartment

12 Family Apartment, Cator Ave., Jersey City, N. J.



and gave the owner $720 a year more rent

HERE was a 12 family apartment that needed modern heating. Here was an owner who did not realize that increased rents would soon pay for his investment and continue to give him an extra income.

And here was a wide-awake heating contractor who told the story of modernization convincingly. The owner invested $3000. The tenants were glad to pay $720 a year more rent for real comfort. And the contractor made a real profit.

If you are not already a qualified user of our Time Payment plan as announced on the radio every Thursday night, ask the salesman to tell you about it. Or write us for details.

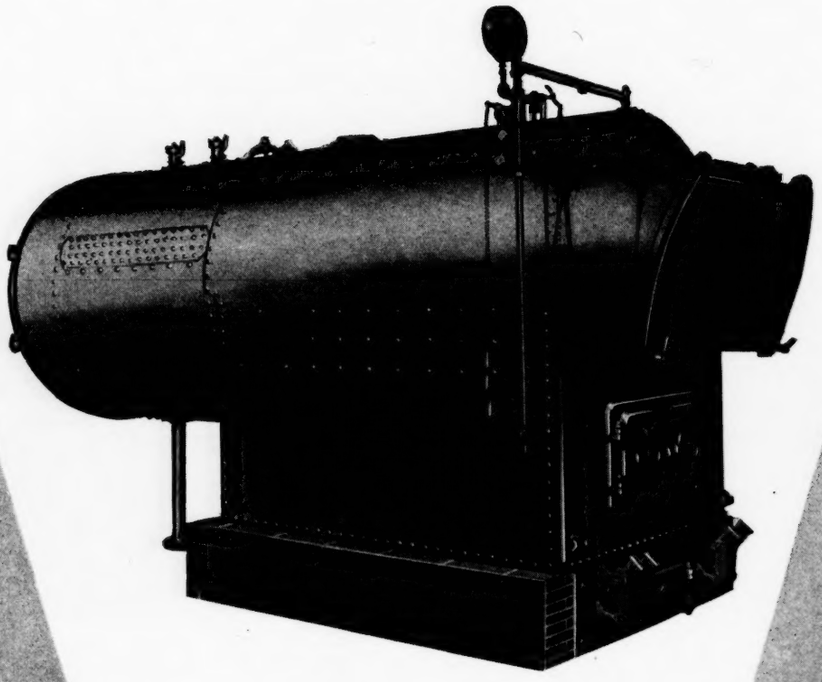
AMERICAN RADIATOR COMPANY

40 WEST 40th STREET, NEW YORK, N. Y.

Division of

AMERICAN RADIATOR & STANDARD SANITARY CORPORATION

COATESVILLE BOILERS



Some COATESVILLE Features

1. Crown sheet self-supporting.
2. Self cleaning crown sheet.
3. Adjustable Hinges. (Insuring tight fit of all doors.)
4. Flue doors close against an asbestos packing ring.
5. Insulated rear combustion chamber.
6. Special steam separator.
7. Adjustable clamps for precise alignment of grates.
8. Large steam space entirely accessible.

COATESVILLE STEEL HEATING BOILERS

COATESVILLE BOILER WORKS

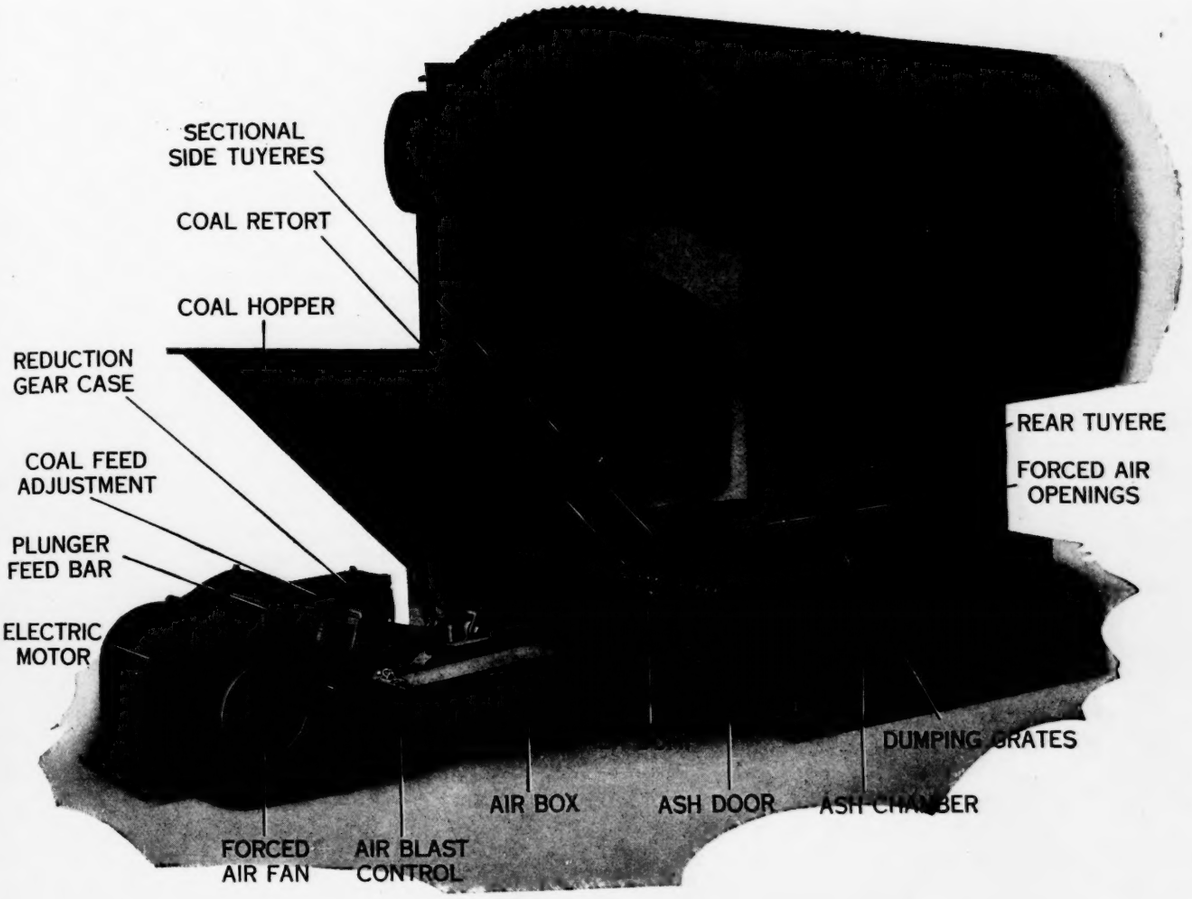
Boilers - Tanks - Steel Plate Work

Main Office and Works—COATESVILLE, PA.

Philadelphia 111 S. 15th St. | New York 30 Church St. | Newark 60 Park Place | Boston 141 Milk St. | New London 325 State St. | Pittsburgh Union Trust Bldg.

Baltimore Lexington Bldg. | Washington, D. C. 208 Evans Bldg. | Richmond, Va., Railway & Power Bldg.

Newport News, Va. 3100 Virginia Ave. | Bristol, Tenn.-Va. 607-609 State St. | Greensboro, N. C. North Carolina Bank Bldg. | New Orleans 1811 Masonic Temple | Dallas, Texas 1505 North Haskell Ave.



Outstanding Advantages of DETROIT JUNIOR STOKER

Plunger Feed Gives Control of Fuel Bed

Only with this system is combustion controlled and an even fire of proper depth maintained throughout the fuel bed. By simple adjustments of the stroke of the plunger the amount of coal fed and its distribution within the furnace are mechanically controlled. The depth of the fuel bed is uniform so that all of the coal is completely burned.

Mechanical Dump—Ashes Dumped Into a Pit

Designed on same principles as large side cleaning stokers. A mechanical dump is located within the furnace, so that without disturbing the fire, ash and refuse may be dropped to the ashpit and allowed to cool before removal. This keeps the boiler room clean and free from smoke, foul gases, dust and ashes. No disturbance of fire.

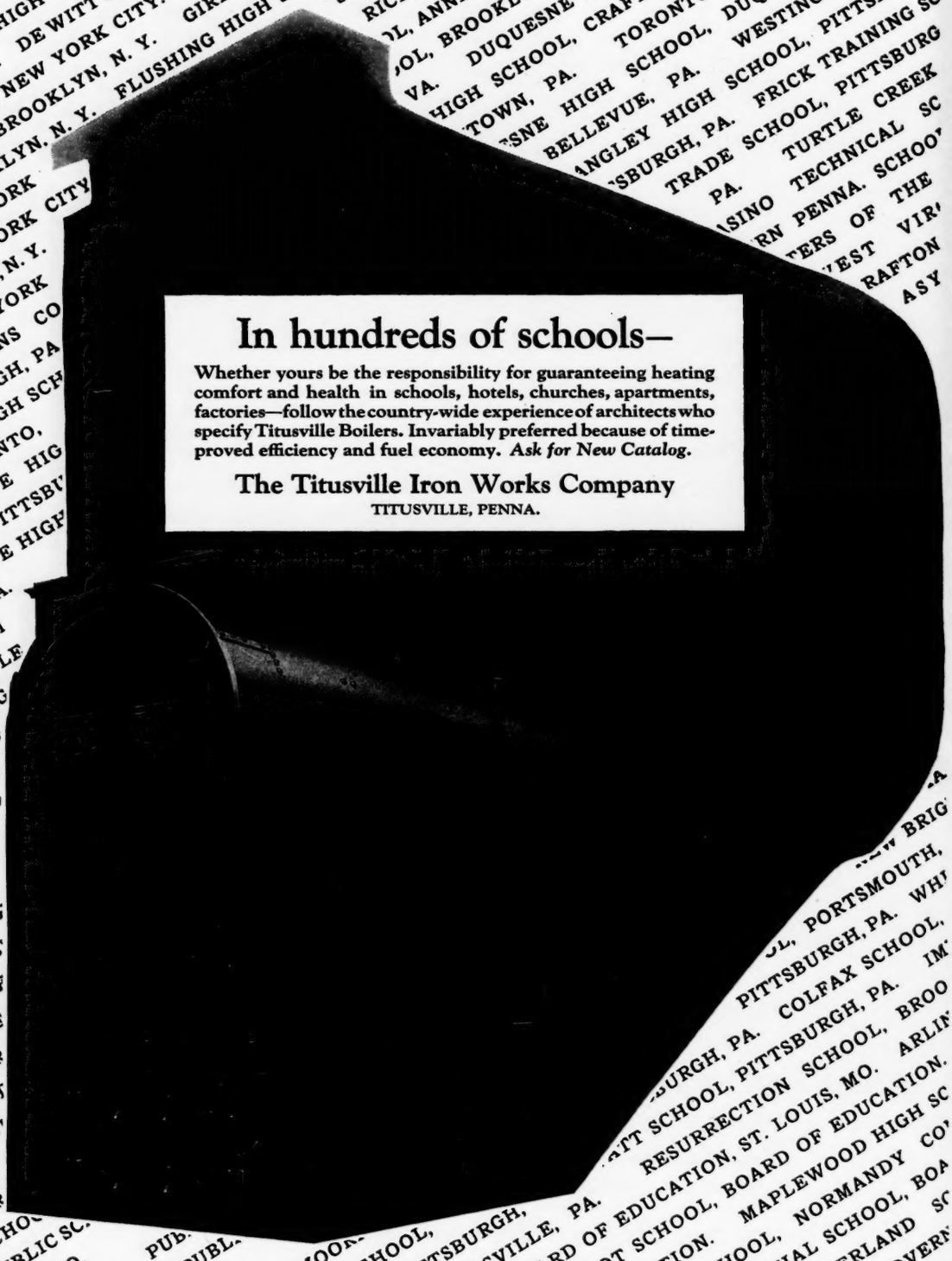
For Every Service—A Detroit Stoker

Descriptive matter on Detroit Stokers for boilers of every type and size from the smallest to the largest sent on request for general catalog. For Detroit JUNIOR Stokers ask for Bulletin 373.

DETROIT STOKER COMPANY
Third Floor General Motors Building DETROIT, MICHIGAN

DETROIT JUNIOR STOKER

A TRIUMPH IN COMBUSTION ENGINEERING



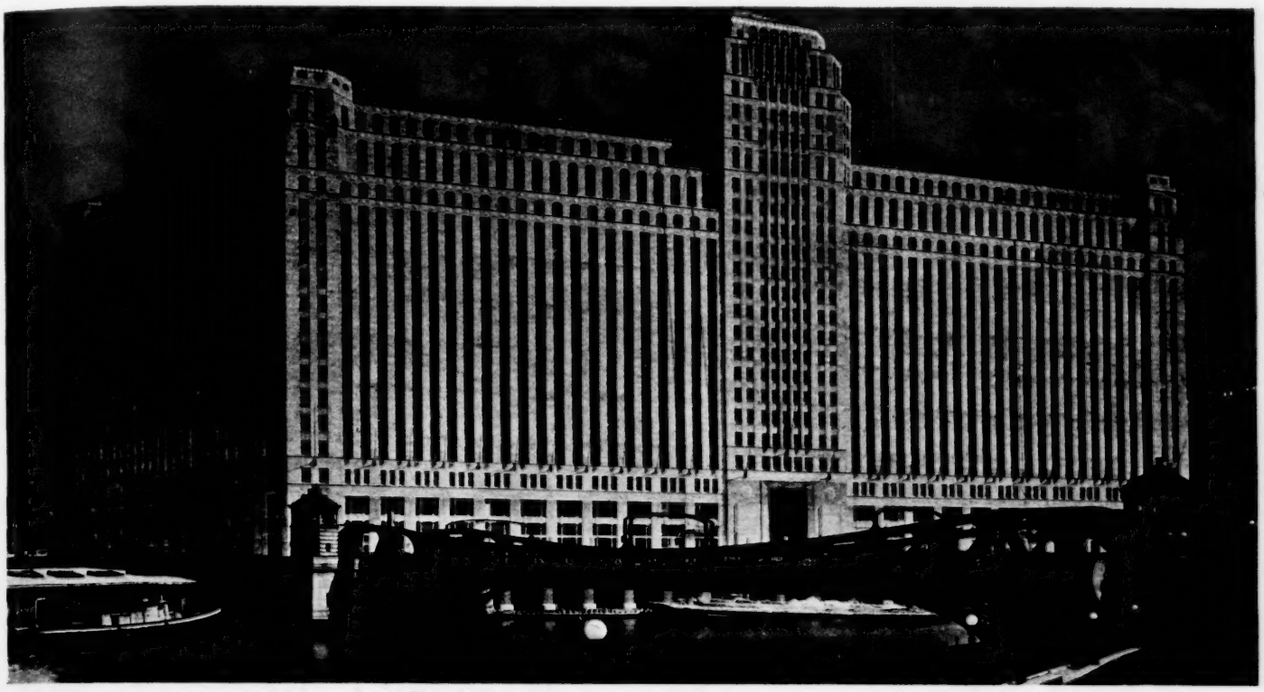
In hundreds of schools—

Whether yours be the responsibility for guaranteeing heating comfort and health in schools, hotels, churches, apartments, factories—follow the country-wide experience of architects who specify Titusville Boilers. Invariably preferred because of time-proved efficiency and fuel economy. *Ask for New Catalog.*

The Titusville Iron Works Company

TITUSVILLE, PENNA.

TIW-66

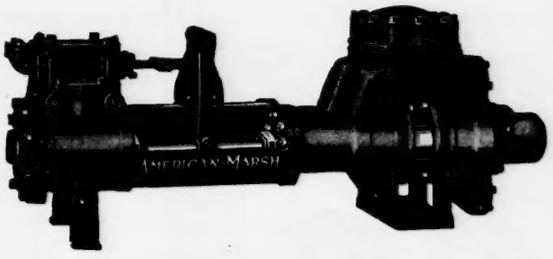


Chosen *for* World's Largest Building

SHOWN above is the Merchandise Mart, Chicago—the largest building in the world.

In this building both boiler feed pumps and vacuum pumps are American-Marsh—seven pumps in all.

The boiler plant is high pressure, operating during the heating season under a total load of 73,800 pounds per hour, and requiring two American-Marsh size 12x7x12 Duplex Boiler Feed Pumps. During the summer two smaller American-Marsh Duplex Boiler Feed Pumps are used in connection with the high pressure boilers which furnish steam for kitchen and laboratory work.



THIS is an American-Marsh Duplex Boiler Feed Pump, outside center packed, plate valve pattern with bronze rods, bronze plungers, and bronze fittings, as installed in the Merchandise Mart. Write for Bulletin 28. Vacuum Pumps, Bulletin 24.

Three American-Marsh size 12x18x20 Duplex Vacuum Pumps are installed, each pump of sufficient capacity to handle one half the total load.

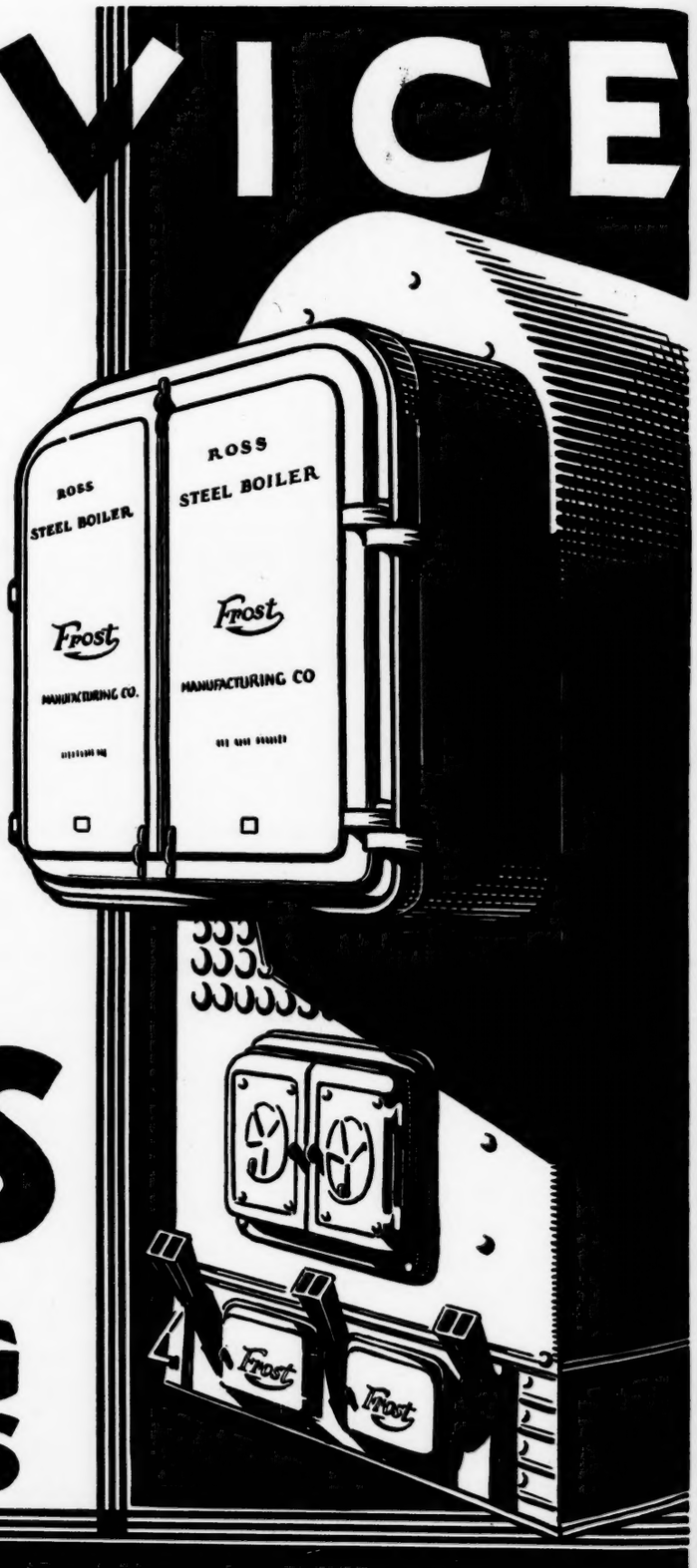
There is nothing finer than American-Marsh Steam Pumps, offered in both simplex and duplex types—a pump for every requirement. The design insures maximum economy; the construction is a guarantee of dependable service. *Very definitely it will pay you to consult with our engineers.*

AMERICAN STEAM PUMP COMPANY
BATTLE CREEK, MICHIGAN
Sales Engineering Offices in Principal Cities

AMERICAN-MARSH
SIMPLEX and DUPLEX STEAM PUMPS

SERVICE

Minimum installation expense, economical operation, and durable construction are deciding factors in present-day heating installations. ▾ ▾ ▾ ▾ ▾ These requirements are incorporated in



ROSS STEEL HEATING BOILERS

THE FROST MANUFACTURING CO.
GALESBURG, ILLINOIS
Established 1851

A Prominent Boiler Manufacturer Writes . .

"I think this is a mighty good record—The Stoker has been operating for five years and there has been no mechanical trouble whatever, nor parts replaced."

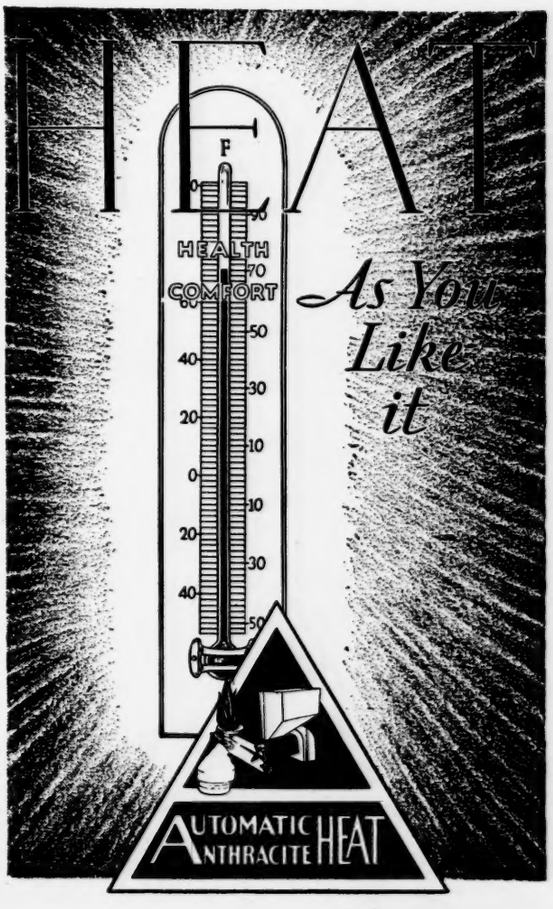
THE ELECTRIC FURNACE-MAN satisfies the most exacting demands. Records of years of service carry *more weight* than blueprints. It is easy to make claims but actual performance is what you are interested in. Demand evidence of reliability, stamina and efficiency which only years of service *in every type of heating plant* can provide.

The ELECTRIC FURNACE-MAN has more than 10,000 installations to its credit. Each year its sale is expanding through the influence of increasing thousands of satisfied customers — a growing recognition of the SAFETY, CONVENIENCE, CLEANLINESS and ECONOMY of this time-tested system of AUTOMATIC HOME HEAT with PENNSYLVANIA ANTHRACITE (Buckwheat sizes)—the ideal domestic fuel.

HOME OWNERS have now had time to weigh the evidence—comparing the comfort and security as well as the economy of the ELECTRIC FURNACE-MAN with other devices using substitute fuels. They have discovered that the ELECTRIC FURNACE-MAN is the modern and efficient means of obtaining automatic heating comfort.

350 distributors and dealers in principal cities—

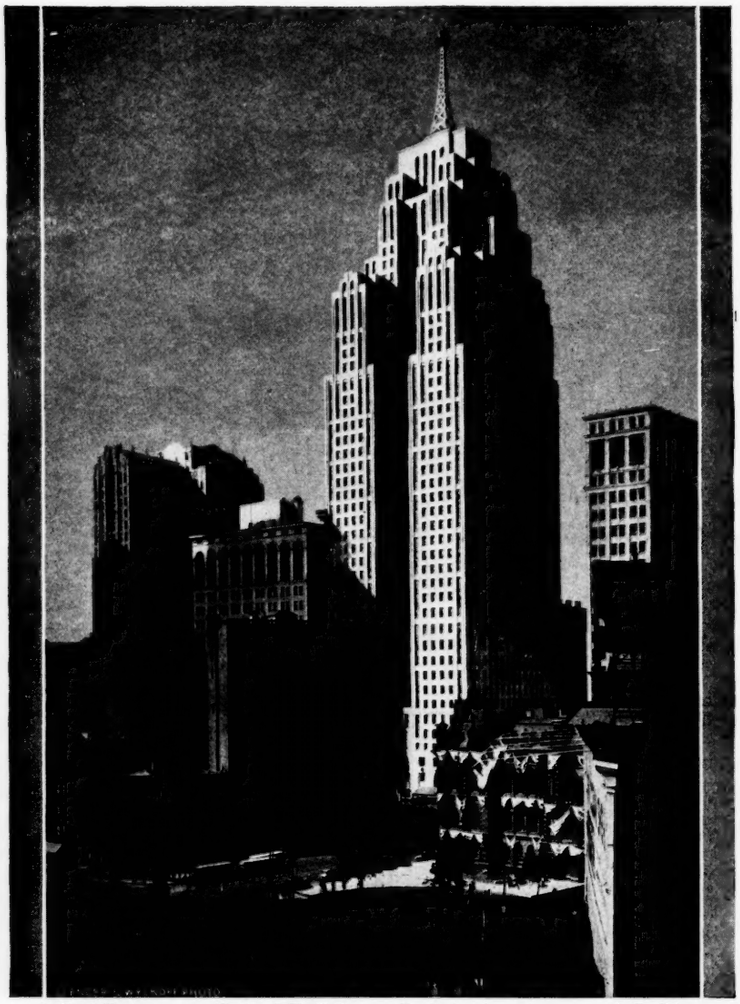
prepared to make authoritative heating surveys and fully guaranteed installations for home heating, small commercial purposes, and hot water supply in apartments, clubs, hotels and public buildings. Consult our local dealer or write for descriptive literature.



The Electric Furnace-Man

(Patented Automatic Coal Burner)

Domestic Stoker Company **7 Dey Street, New York**



Architects-Engineers Smith, Hinchman & Grylls

Heating & Ventilating H. Kelly & Co.

Fan System Apparatus American Blower Corp.

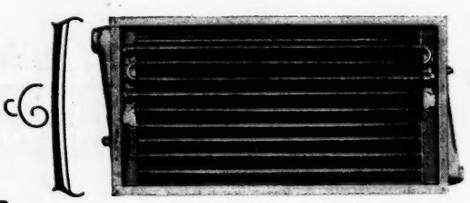
Air Conditioning Cooling and Air Conditioning Corp.

—and in the MOTOR CITY'S TALLEST BUILDING

AEROFIN *is the* Heat-Surface

TOWERING six hundred sixty-five feet above the Street, the magnificent new Penobscot Building dominates Detroit's rapidly rising skyline. And, of course, AEROFIN is the Heat-Surface,—in the Building itself and as a part of the Air Conditioning Equipment which assures comfort and health in the Guardian Detroit Bank, occupying the lower floors.

If requested on your business letterhead Newark will be glad to send you a complete and useful Bulletin. Ask for Bulletin V-80,—and a Folder describing BOOSTER UNITS AEROFIN, another pioneer contribution to Fan Engineering,— will be included.



The Standardized Light-Weight Fan System Heat-Surface

4 Types 196 Standard Sizes

Pressures up to 350 lbs. gauge

Section illustrated is UNIVERSAL AEROFIN, 2½ to 200 lbs.

AEROFIN is sold only by Manufacturers of Nationally Advertised Fan System Apparatus.

List upon Request

AEROFIN CORPORATION

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United Artists Building DETROIT

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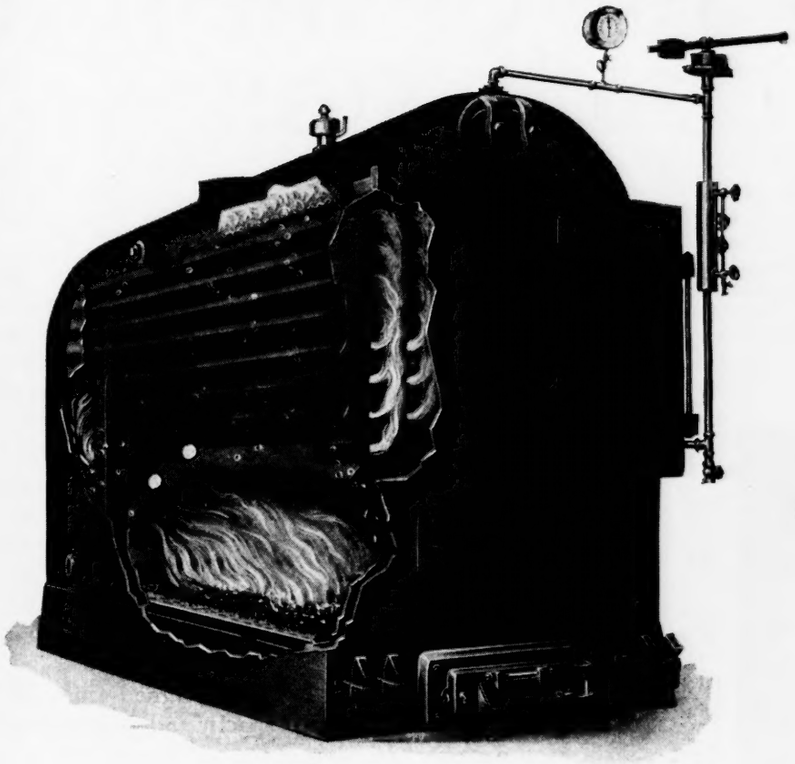
Paul Brown Bldg. ST. LOUIS

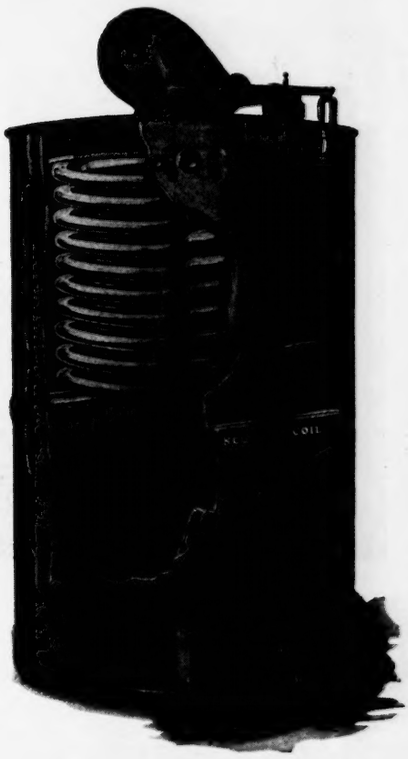
MONCO



STEEL HEATING BOILERS

for

COAL OR OIL BURNING



MONCO

COIL HEATING BOILERS

COIL WATER HEATERS

for

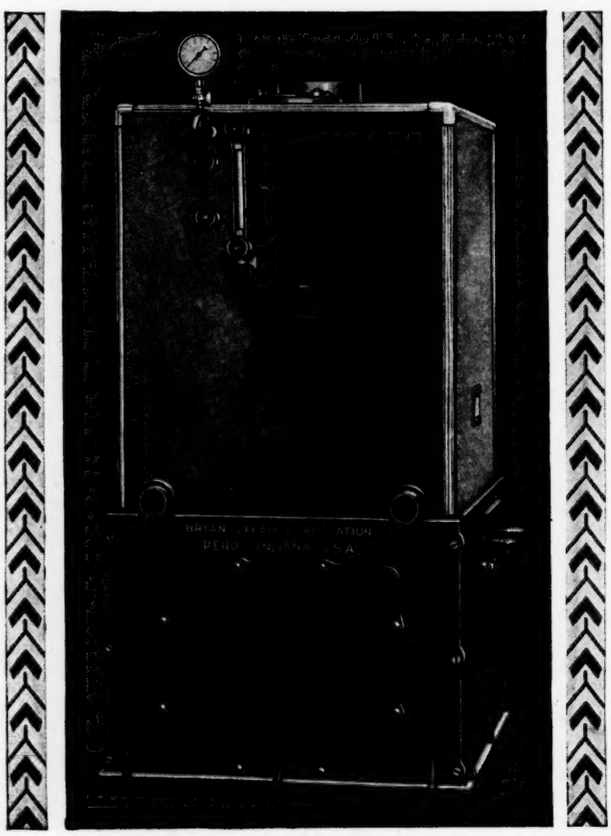
COAL OR OIL BURNING

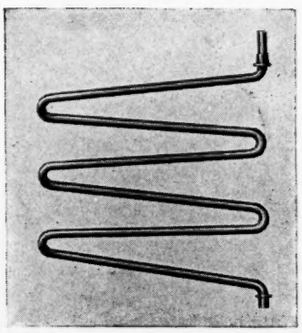
MONITOR BOILER CO., 1505 Race St., Philadelphia, Pa.

Affiliated with UNITED DRY DOCKS, INC., NEW YORK

SAVES 30% TO 50% OF THE FUEL BY SPECIALIZED DESIGN

AT THE RIGHT: *One of the many copper-tube sections which are the keystone of Bryan Boiler performance. These sections break the water into small streams which are driven through the hottest part of the boiler at a very rapid rate, thus absorbing and delivering to dome and radiation more heat in a given time than any other type of boiler.*





OIL-HEAT is generated *quickly!* And, by the same token, it can be lost just as quickly, if the boiler cannot absorb the heat as fast as it is produced.

Naturally, the coal-burning type of boiler, designed to work efficiently with the slow, even heat of a coal fire, does not operate with equal fuel economy when burning oil. The combustion characteristics of oil and coal are too widely separated for any one type of boiler to work equally well with both fuels.

The Bryan Copper-Tube Boiler—designed from the outset for use with oil—has the capacity and *speed* of heat absorption necessary to capture the sudden and intense heat of the oil-burner. As a result, Bryan Boilers consistently show a fuel saving of 30% to 50% over other types of boilers.

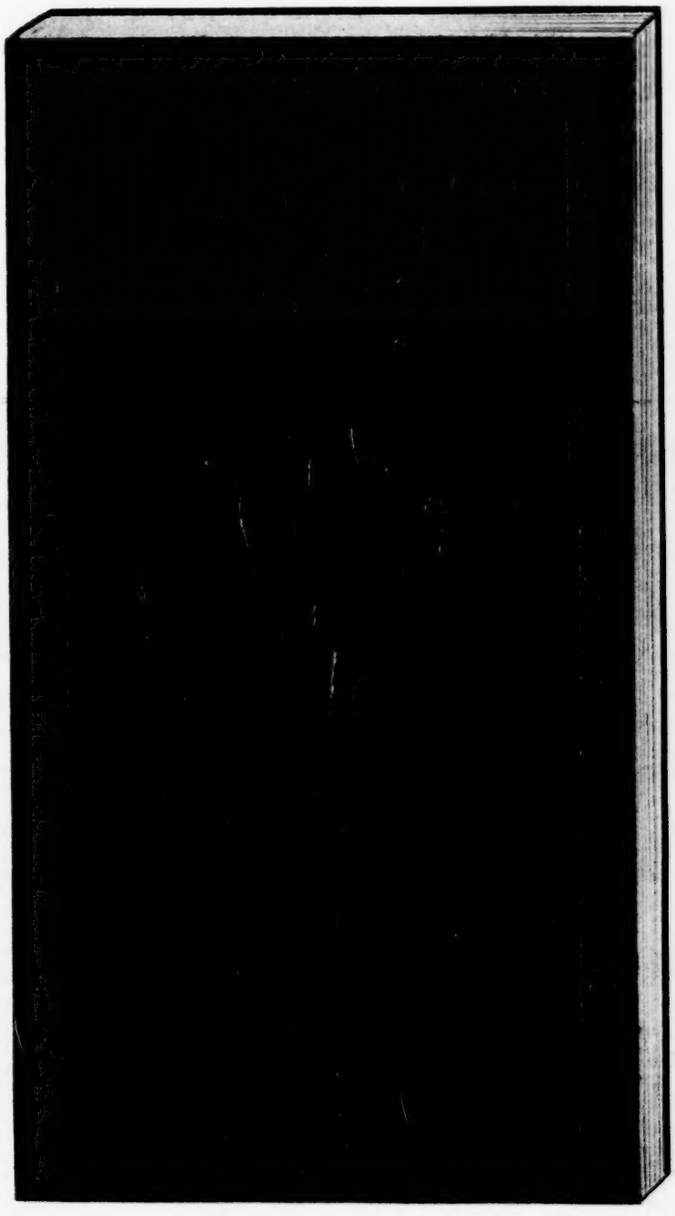
Copper tubes—capable of absorbing heat nearly eight times as fast as cast iron—and an entirely new principle of construction which increases water circulation proportionately, are just two of the features which have enabled Bryan Boilers to effect such fuel savings in homes throughout the country. The complete story of Bryan Copper-Tube Boilers, for oil and gas, is contained in the Bryan catalog. We will be glad to forward it to you, if you do not already have it. Please write.

BRYAN STEAM CORPORATION
(Boiler Division)
PERU, INDIANA

BRYAN Copper-Tube BOILERS

MERCOID

COMPLETE CATALOG OF AUTOMATIC CONTROLS
FOR OIL BURNERS, UNIT HEATERS ETC.



Write for Your Copy

ADDRESS DEPT "H"

THE MERCOID CORPORATION
4201 BELMONT AVE., CHICAGO, ILL.
25 CHURCH ST., NEW YORK. 1129 FOLSOM ST., SAN FRANCISCO

MERCOID CONTROLS

Union & New Haven Trust Company Building
New Haven, ... Connecticut
Cross and Cross . . . *Architects* . . . New York

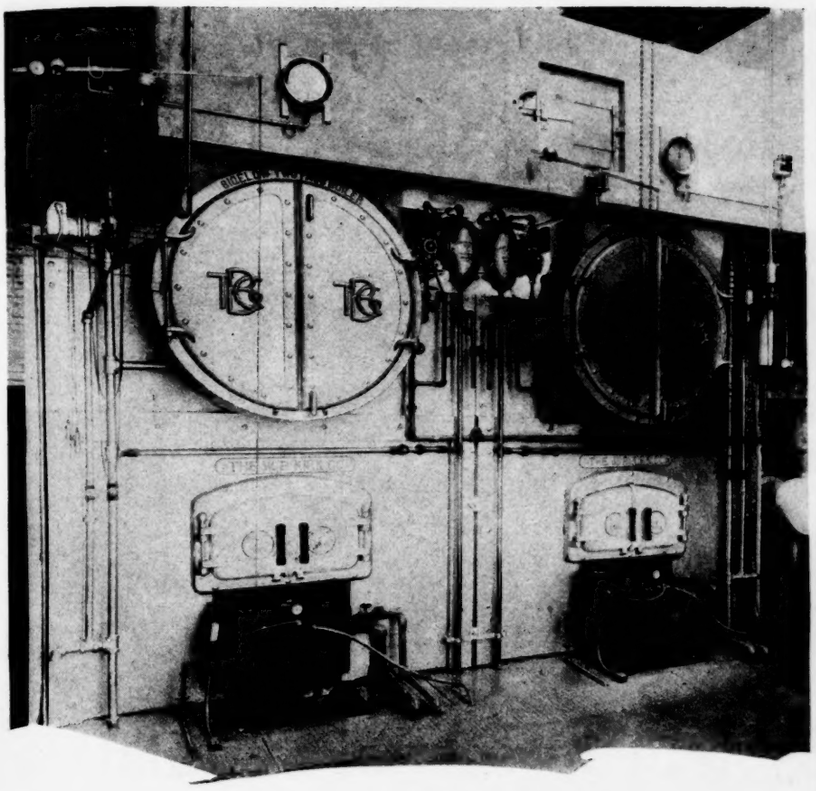
Johnson Heat Control In This Building

The first floor, mezzanine and half the basement are used as banking and safe deposit quarters. This space is heated by direct radiation, automatically controlled by 21 Johnson wall thermostats connected directly with Johnson valves on the radiators. The indirect heating system, which also serves to ventilate this space in summer, consists of exhaust and supply fans, the latter equipped with oil screen filters. The heating units in this system and the louvres controlling the air supply are controlled by Johnson Thermostats. Louvres are also in the bank's skylights, and are operated by Johnson Control from a switchboard panel in the Superintendent's office. General offices, from the second to the twelfth floors, inclusive, are heated by direct radiation; and the steam supply is divided to heat independently five tiers, each Johnson Controlled from the switchboard panel in the Superintendent's office.

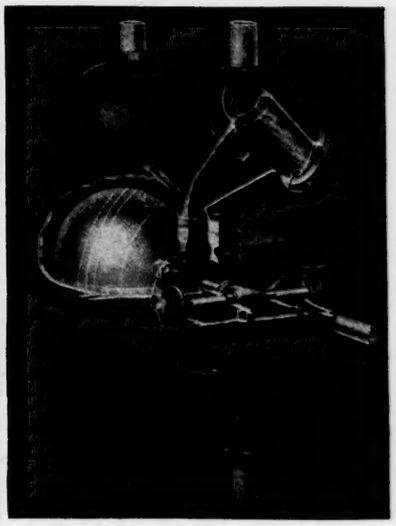
Johnson Control applies to every system, form and plan of heating and ventilating: interestingly described complete in the Johnson book, sent gratis on request.

JOHNSON SERVICE CO., 149 E. Michigan St. MILWAUKEE, WIS.
ESTABLISHED 1885
BRANCHES IN ALL PRINCIPAL CITIES

THE ALL METAL SYSTEM. THE ALL PERFECT GRADUATED CONTROL OF VALVES & DAMPERS. THE DUAL THERMOSTAT CONTROL

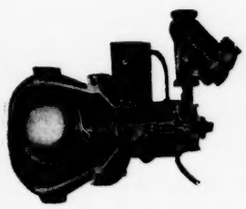


This trim installation of McDonnell No. 28 Self-Cleaning Duplex Feeders is in the Southern New England Telephone Co. Bldg., at Bridgeport, Conn. The heating contractor was W. P. Kirk Co. of Bridgeport.



There's nothing wrong with *this* picture!

{The McDonnell Feeders show that the engineer is in step with progress}



For Oil-Fired or Stoker-Fired Jobs

Here is an ingenious combination—the McDonnell No. 30 Safety Feeder combined with the McDonnell No. 31 Emergency Switch. The feeder takes care of normal operation, and the switch takes care of foaming and priming. Entire combination costs little more than the feeder alone.

"To forget is human." That is why people forget the boiler water line. However, there is every indication that an ever-growing number of engineers are *not* forgetting to install the device that *never forgets.*

Each year brings increasing evidence that McDonnell Boiler Feeders are rapidly coming to be regarded as a standard part of the up-to-the-minute heating installation. The engineer who specifies them, proves that he is a long step ahead of the engineer or contractor who doesn't!

There is no longer any reason for limiting McDonnell protection to larger boilers. The McDonnell No. 30 Safety Feeder offers McDonnell dependability and quality in a moderate priced feeder that can be justified for even the smallest boilers. It is ideal for those who prefer a feeder that operates only when the boiler water line drops to the danger level—a modern practice that is advocated by many engineers in connection with moderate or small sized boilers.

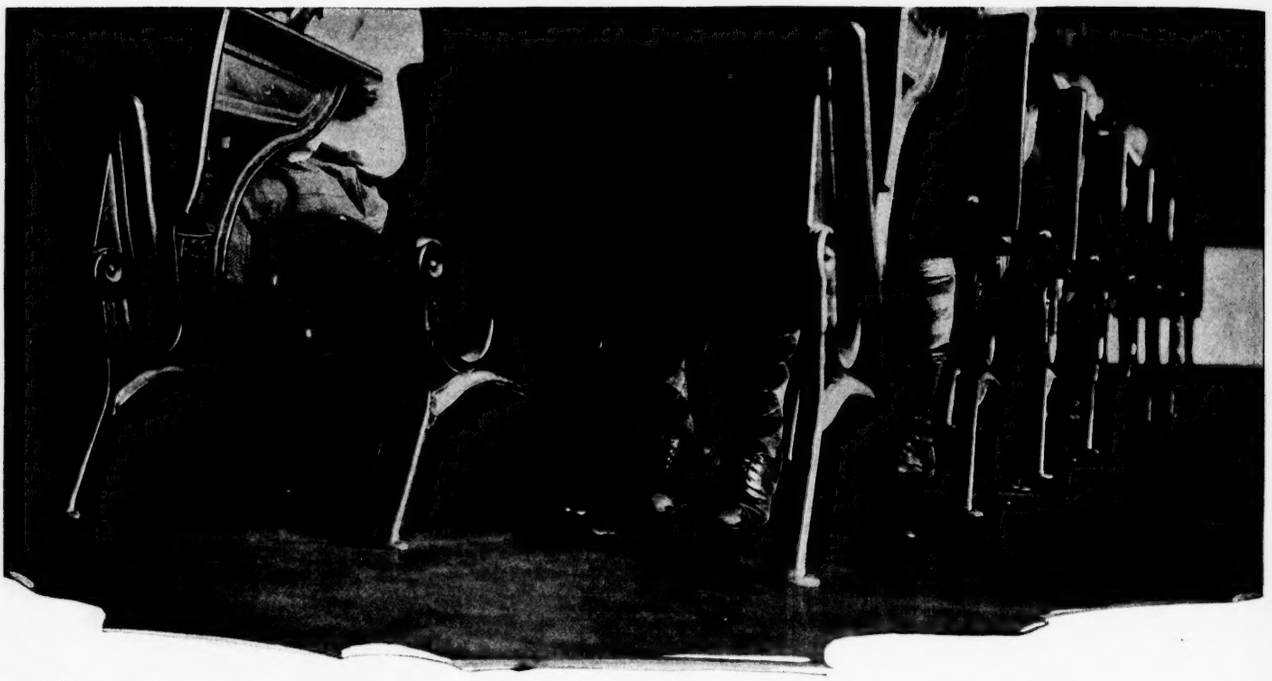
Every hand-fired job needs McDonnell protection, and the automatic job fairly shouts for it. The comfort and convenience argument doesn't ring true where it's necessary to watch the boiler water line.

Are you fair to yourself and to those whom you serve, if you refuse to recognize the growing trend toward McDonnell protection for every boiler installation?

McDONNELL & MILLER
1314 Wrigley Building, Chicago
Eastern Office: Grand Central Terminal, New York

McDONNELL & MILLER
Boiler Feeders

"Doing one thing well"



The PeerVent System in school ventilation ensures a more even temperature

IN the schoolroom, especially during the winter months, when the pupils' feet are more or less damp from rain and snow, the temperature variation between the breathing line and the floor line should be no more than 2 degrees. In the average incorrectly-ventilated schoolroom, the temperature variation is often 10 degrees.

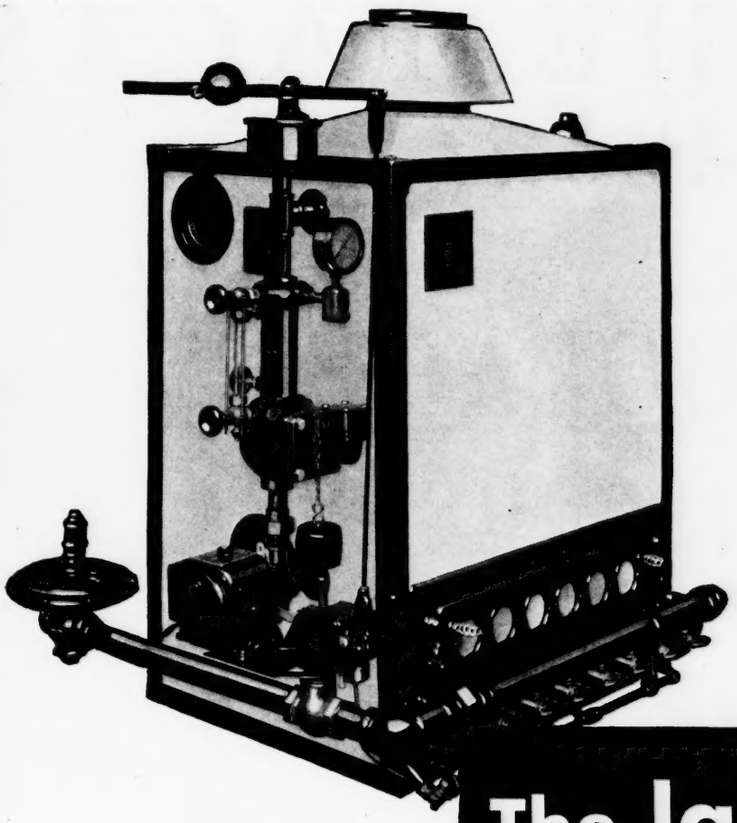
Correct ventilation is easily obtained. The use of the PeerVent System, when properly installed and with correctly located air inlets, reduces this temperature variation to about 2 degrees. Each PeerVent is entirely independent, as the cost of operation depends upon the actual service rendered in the one room where the unit is located. The PeerVents in unoccupied rooms need not be operated. The fresh air discharged from the PeerVent is so completely diffused that it eliminates any blasts of over-warm air. Pupils can stand or sit close to the PeerVent without discomfort. Besides being economical to run, PeerVents are also absolutely quiet in operation.

PeerVent Systems should be used not only in schools but in all other public and semi-public buildings, such as libraries, hospitals, dormitories, club rooms, theatres, hotels, banks, and for all other buildings where many people congregate and where need for ventilation exists.

You owe it to your clients to investigate the new PeerVent System.

PEERVENT

PEERLESS UNIT VENTILATION CO., Inc.
BRIDGEPORT, CONNECTICUT
Pioneers in Unit Ventilation
Resident Engineers in Principal Cities from Coast to Coast



The last word in AUTOMATIC HEATING

IDEAL GAS BOILERS

Automatic house heating has come to stay. And heating that is 100% automatic is now possible for every building with Ideal Gas Boilers. Heating contractors everywhere are finding this new source of profit. If you want your share of the profits that Ideal Gas Boilers are bringing—if you want to make this a prosperous season—find out now about Ideal Gas Boilers.

- Entirely automatic, clean, noiseless and efficient—these boilers require no servicing and no attention throughout the heating season. There is no fuel storage or handling, no dirt or dust and no ash removal.

manufactured by

AMERICAN RADIATOR COMPANY

40 West 40th Street, New York

division of

AMERICAN RADIATOR & STANDARD SANITARY CORPORATION

GET THE FACTS

About

The CARBORADIANT

REG. U.S. PAT. OFF.

OIL BURNER

FULLY TESTED, new, exclusive features that add considerable advantages in ease of installation, positive safety and a high rate of efficiency . . . made by a well known company of large resources in plant and engineering facilities and experience.

Offered for distribution in New York and suburban areas of Long Island, Northern New Jersey, Westchester and lower Connecticut.

Dealers located there are urged—in their own best interests—to *get the full facts.* Gladly sent upon receipt of inquiry or just sign the coupon.

THE CARBORUNDUM COMPANY

OIL BURNER DIVISION PERTH AMBOY, N. J.

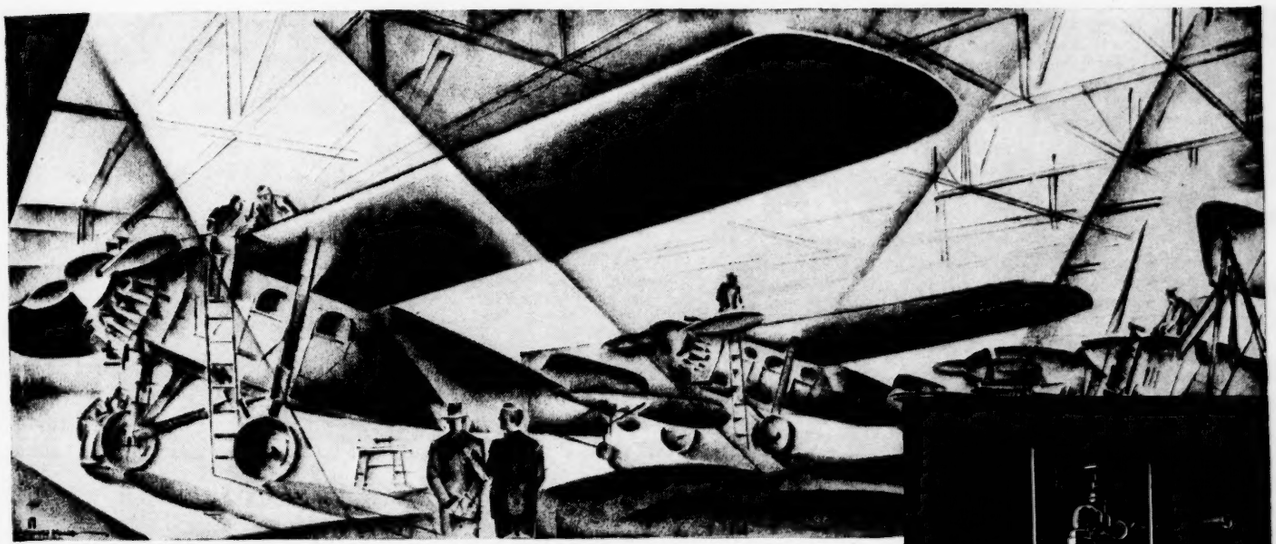
Carborundum Company
Perth Amboy, N. J.
Send full facts re Carboradiant Burner.

Name _____

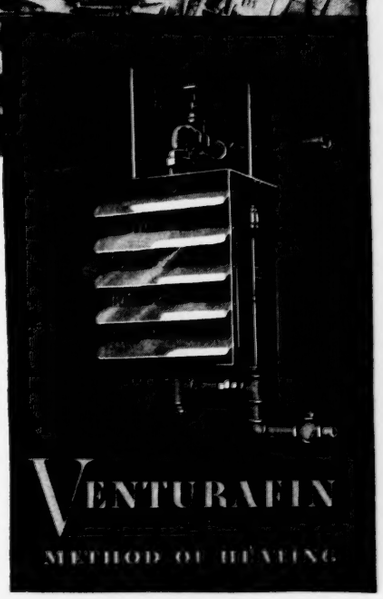
Address _____

WHEN HEAT IS Controlled

. . working conditions are right



HEAT WITH UNIT HEATERS



Venturafin Units can be mounted on wall, column or ceiling with ordinary ¾-inch hanger pipes. Heat control with Venturafin Units becomes automatic by the application of a Mercoid Thermostat.

It is easy to maintain an even temperature—not too hot, not too cold—throughout a building . . . to keep workers comfortable and contented, after Venturafin Unit Heaters are installed and heat becomes *controlled.*

Equipped with an individual three-way heat control switch, each Venturafin Unit forces heated air at LOW, MEDIUM or HIGH speed—at exactly the required velocity to correct irregularities of temperature in a building. Individually adjustable streamline air-jet deflectors direct heated air in one or several directions simultaneously. Venturafin Unit Heaters force heated air *where* you want it, *when* you want it and *as much as* you want.

Venturafin Units are ideal for heating factories, shops, stores, garages, and many other types of buildings, new or old. They are easy to install and can be used on high, medium or low pressure steam applications. Backed by a sound and extensive national and trade magazine advertising as well as a special merchandising program, they offer an increasing opportunity for profits. Write today for our story on how you can handle the profitable Venturafin line without increasing your overhead.

AMERICAN BLOWER CORPORATION, DETROIT, MICHIGAN
CANADIAN SIROCCO COMPANY, LIMITED, WINDSOR, ONTARIO
BRANCH OFFICES IN ALL PRINCIPAL CITIES

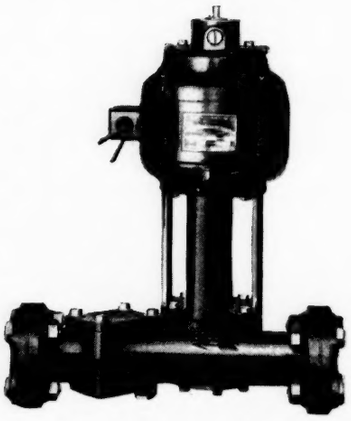
(1040)

Venturafin Units for industrials are equipped with a three-speed heat control switch.

American Blower

"Sirocco" VENTILATING, HEATING, AIR CONDITIONING, DRYING, MECHANICAL DRAFT
MANUFACTURERS OF ALL TYPES OF AIR HANDLING EQUIPMENT SINCE 1881

Pays For Itself in Fuel Savings Alone!



When there's a HYDROLATOR on a hot water heating plant, the whole system gets more heat and fuel bills are lower!

The HYDROLATOR, by means of a centrifugal pump drives the water through the system several times faster than ordinary thermal circulation.

Temperature differential between flow and return is seldom greater than 15 degrees and often as low as 5.

The HYDROLATOR pays for itself in fuel savings alone!

NEW YORK
SINGER BUILDING
149 BROADWAY

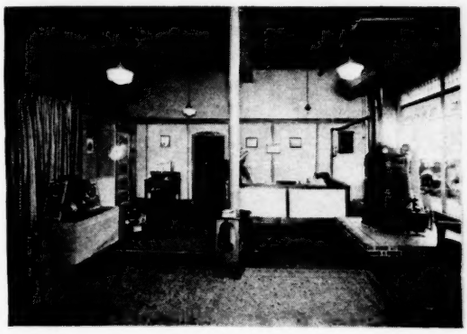
Janette Manufacturing Company
556-558 West Monroe Street
Chicago

PHILADELPHIA
REAL ESTATE
TRUST BUILDING

PLAIN TALKS ON OIL BURNER PROFITS

No. 4—Three Reasons Why Electrol Dealers Are SATISFIED

1. Electrol, Inc., has always been willing to cooperate in the solution of any dealer problem which has arisen.
2. Electrol *alone* offers the exclusive features which make it easy to sell, easy to service, flexible and efficient in operation.
3. Electrol dealers MAKE MONEY!



The Electrol Nassau Corporation, distributors for Electrol Oil Burners for Nassau and Suffolk counties on Long Island, New York, does a large volume of business in an extremely competitive market under all sorts of conditions. Their volume is consistent and they show a good profit *year after year.*

Member of the Oil Heating Institute

Read What Mr. Ted H. Cox Says:

"We have always found Electrol, Inc., most willing to cooperate with us on any merchandising problem that confronts us. We attribute our success in a large degree to the fact that we handle no other burner and that we are representing a reliable manufacturer who is interested in our success. WE CAN'T HELP BUT MAKE MONEY!"

There is no secret in the Electrol dealer's satisfaction. "Some of our Electrol Burners have been installed for 5 years," says Ted Cox, "and judging from their performance every Electrol Burner could break all endurance records." It is not difficult to sell an Oil Burner having the exclusive features enjoyed by Electrol. Safety Control—built right into the burner. Flexibility—adaptable to any type boiler. Electric ignition. Ball-Shaped Flame and Slow Combustion—for economy. A burner that never wears out. In addition, a margin of profit that is most attractive. Investigate the Electrol proposition for yourself.

For the Heating Contractor— a Profit Either Way

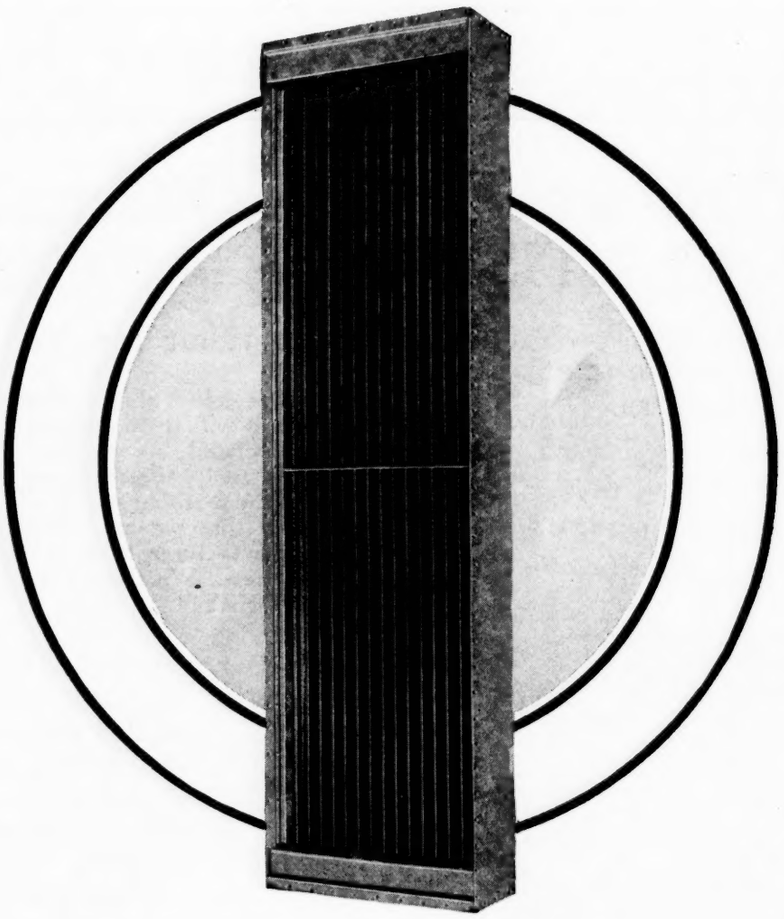
1. THE ELECTROL FRANCHISE. There's a nice profit in the Electrol Franchise for the Heating Contractor. This is abundantly proved by the success achieved by many leaders in the business.
2. THE ELECTROL COOPERATIVE PLAN. You will find the Electrol dealer in your territory prepared to make an attractive cooperative arrangement. One that adds to your income; safeguards your professional reputation and requires no extra investment. Let us give you details.

ELECTROL

The* OIL BURNER *with the Master Control

227 East 45th Street, New York City

ELECTROL, INC., H
227 East 45th Street, New York
I would like to know more about—
The Electrol Franchise_____
The Electrol Cooperative Plan_____
Name_____
Address_____
City_____ State_____



Some recent installations of

ARCOBLAST
ENCASED HEATERS

Murray Body Co. . . .	Detroit, Mich.
Chance Vaught Co.	East Hartford, Conn.
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Battle Creek School	Battle Creek, Mich.

ALBERT KAHN Inc.
Architects and Engineers
Detroit, Mich.

Encased Arcoblast Heaters are increasing in popularity with architects and engineers whose judgment of selection is based on results obtained, both as to performance and durability.

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Division of
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Chicago, Ill.

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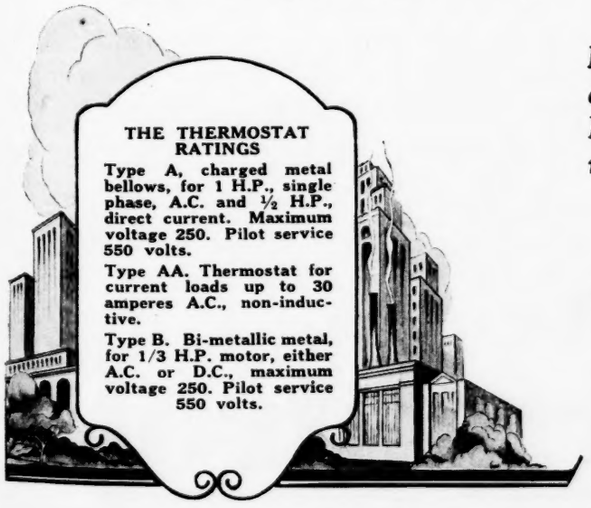
New York, N. Y.

Pedigreed Performance

for the Automatic Control of every type of Heating System ···

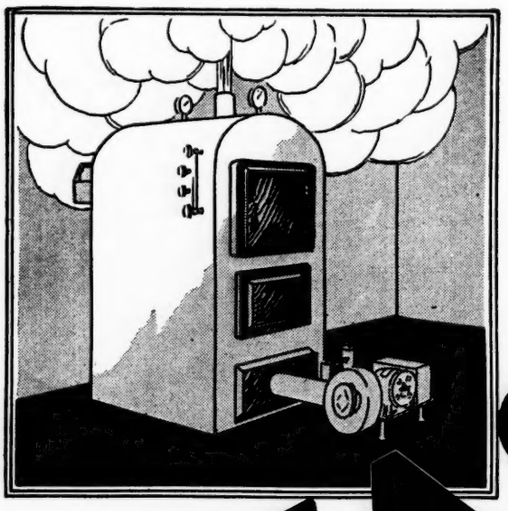
DAY and night, through year after year, Penn controls shoulder their share of the burdens of industry. They deliver the utmost in heat regulation and fuel savings to their operators on all types of heating systems—from the smallest dwelling to the largest of modern office and factory buildings. Pedigreed Performance, it might be called, for these controls reflect the product of 14 years of Penn engineering craftsmanship. There is a Penn Control to fit every type of heating system, whether fired by oil, gas, coal or electricity.


THE THERMOSTAT RATINGS
Type A, charged metal bellows, for 1 H.P., single phase, A.C. and ½ H.P., direct current. Maximum voltage 250. Pilot service 550 volts.
Type AA. Thermostat for current loads up to 30 amperes A.C., non-inductive.
Type B. Bi-metallic metal, for 1/3 H.P. motor, either A.C. or D.C., maximum voltage 250. Pilot service 550 volts.

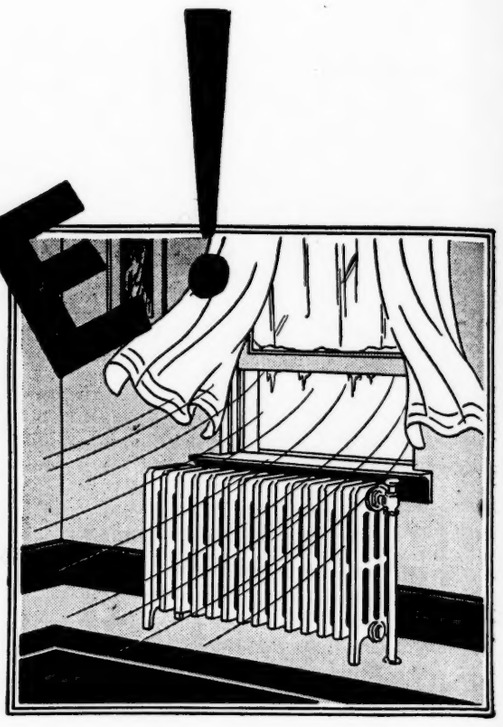
For further information on the controls for any type of heating system, write the Penn Laboratories. Our staff of competent engineers are at your disposal.

PENN ELECTRIC SWITCH CO.
DES MOINES, IOWA

A Complete Line of Automatic Electric Switches for
OIL BURNERS UNIT HEATERS GAS AND ELECTRIC HEATERS
PUMPS AND AIR COMPRESSORS



WASTE!



No one would operate a boiler with an open supply line

BUT it's only slightly less wasteful to use fuel to overheat rooms and then throw the windows open to cool off.

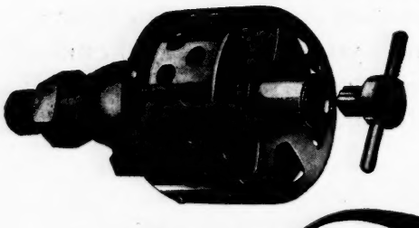
Yet — in thousands of hotels, apartments, offices and homes — this waste is an every-day occurrence. Particularly in income buildings, where tenants have no direct interest in operating costs, the useless waste of fuel is tremendous.

Single thermostatic control, even in small buildings, is unsatisfactory; in large buildings it's impossible. Centrally operated, remote control systems are expensive to buy and install.

WHY NOT USE THE "THERMOTROL"?

Just a simple, self-contained thermostatic valve that replaces the usual radiator valve — that's all. It's easy to install, requires no attention and secures complete control of room temperatures at a minimum of cost.

Write for further information.



STERLING ENGINEERING COMPANY

1644 HOLTON STREET MILWAUKEE, WIS.

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The Thermotrol

28% of all "Silent" installations are made in WARM AIR heating systems

FOR WARM AIR, STEAM AND HOT WATER HEATING SYSTEMS—OLD OR NEW HOMES

HERE is *indisputable proof* that Silent Automatic is *ideally suited* to installation in *warm air* heating systems. Moreover, this percentage of total installations is steadily increasing.

Silent Automatic, because of its NOISELESS wiping WALL-FLAME, has been installed with complete success in *thousands* of WARM AIR heating systems . . . as well as in many thousands of hot water, steam and vapor systems.

Owners of homes heated with warm air are among the thousands of loyal and enthusiastic owners of Silent Automatics whose unqualified "owner satisfaction" has placed "Silent" in its position of *world-leadership.*

This outstanding record of success . . . these thousands of owners who *actively cooperate* in *selling* "Silents" . . . insure the success of "Silent" dealers.

SILENT AUTOMATIC CORPORATION
12001 East Jefferson Ave. Detroit, Mich.

SILENT AUTOMATIC
THE NOISELESS OIL BURNER

Made by the World's Largest Producer of Domestic Oil Burners

(327)

C O U P O N

SILENT AUTOMATIC CORPORATION
Please give me full information on the Silent Automatic Dealer Plan. I want to share in "Silent's" outstanding success

Name_____
Company_____
Address_____
City_____ State_____

Saved $2.50 per Ton of Coal

Read this letter from G. H. Galvin, President, Rockford Board of Education, Rockford, Iowa, to F. A. Naremore, Architect, Seattle, Wash.

"The Rockford Board of Education decided it would be necessary to install a stoker, or increase the capacity of our boiler equipment, for we have not been able to properly heat the two school buildings during the extreme cold weather. We, therefore, made a very thorough investigation of a number of stokers, including both the underfeed and overfeed types, and finally selected the Whiting Stoker, and thus far we have had no cause for regret.

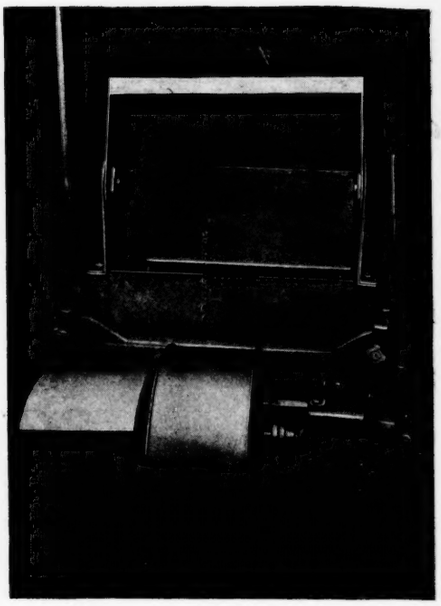
"During the month of January the weather has been quite severe, ranging in temperature from zero to 25 below. Last year, during the severe cold winter, we closed our schools for two or three days, but have had no difficulty since the stoker was installed. As an example, one morning when it was 26 degrees below zero, the janitor started the stoker at 4 A. M. He returned to his home and did not go back to the furnace room until 7 A. M. By that time the temperature in all of the rooms was up to 70 degrees!

"We burn a good grade of Indiana 1¼" screenings, which costs us $4.50 on track at Rockford, or $5.00 in the bin, as compared with $7.50 for Kentucky nut coal, which we found necessary to burn before the stoker was installed. The equipment was installed last fall, and thus far we have had no expense whatsoever. We are not equipped to run an efficiency test, although we are quite sure the stoker will pay for itself in three or four years.

"No, we have no trouble in removing the ashes, for they are automatically dumped just beyond the end of the stoker, where they can be easily removed.

"Yes, I think that the stoker is flexible from small to large loads, for it is equipped with an automatic control, and during the mild weather it requires but little fuel.

"So far as the Rockford Board of Education is concerned, we are more than satisfied. We have received excellent co-operation from the Whiting Corporation, and if we were to buy another stoker, it would be a Whiting."

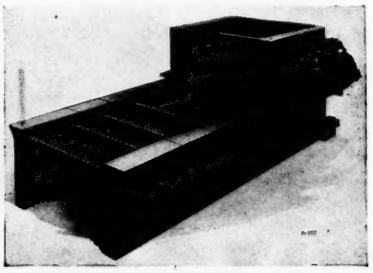


Whiting Model "C" Low Set Stoker
Rockford School, Rockford, Iowa

Investigate the Whiting Stoker

Installed under any boiler from 25 to 250 H. P., the Whiting Stoker will deliver all the advantages mentioned in Mr. Galvin's letter. Hundreds of Whiting Stokers, by burning the cheapest grades of coal and reducing boiler room labor, have effected savings which soon paid for the installation. Capacity is increased 50% as compared with hand firing, *and* smoke is eliminated! Whiting Stokers are designed expressly for small boilers and adaptable to any type.

Whiting Stokers, installed in your plant, will save you money—how much depends on conditions. Write for literature and tell us the size and type of your boilers.



Whiting Model "C" Stoker (Patented)

Joseph Harrington Co.
Subsidiary
WHITING CORPORATION
15695 Lathrop Avenue
Harvey (Chicago Suburb) Illinois
Whiting Corporation (Canada) Ltd., Toronto and Montreal

WHITING STOKER

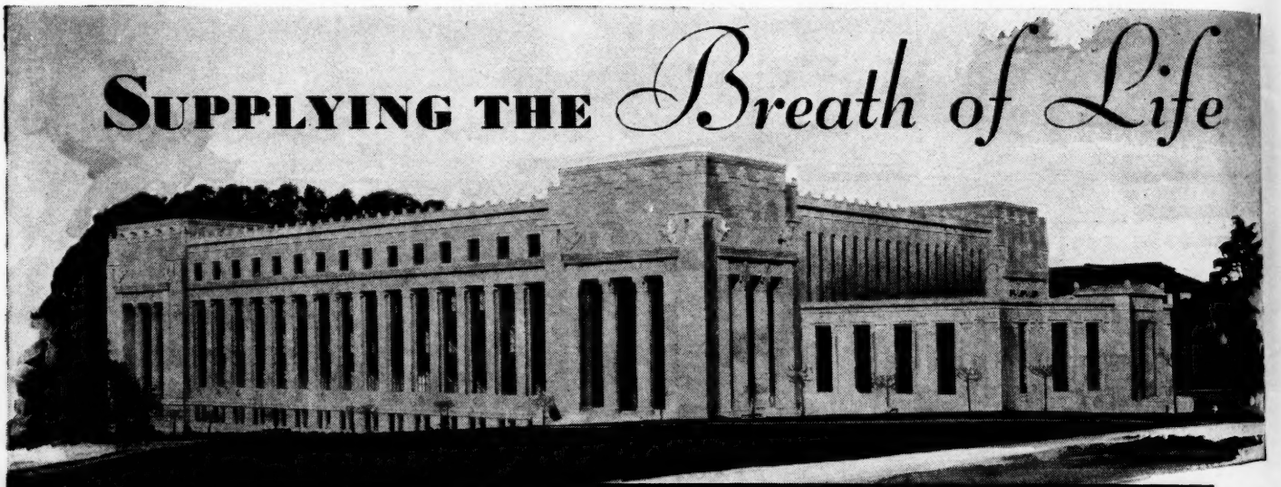
Joseph Harrington, Engineer

30% saving in steam consumption by comparison with conventional vacuum systems is a reasonable expectation with the Webster MODERATOR System of Steam Heating..."Controlled-by-the-Weather." Particularly suited to modern office and loft buildings requiring 10,000 sq. ft. or more of direct radiation. For proof based on two complete seasons of operation, write Warren Webster & Company, Camden, New Jersey.

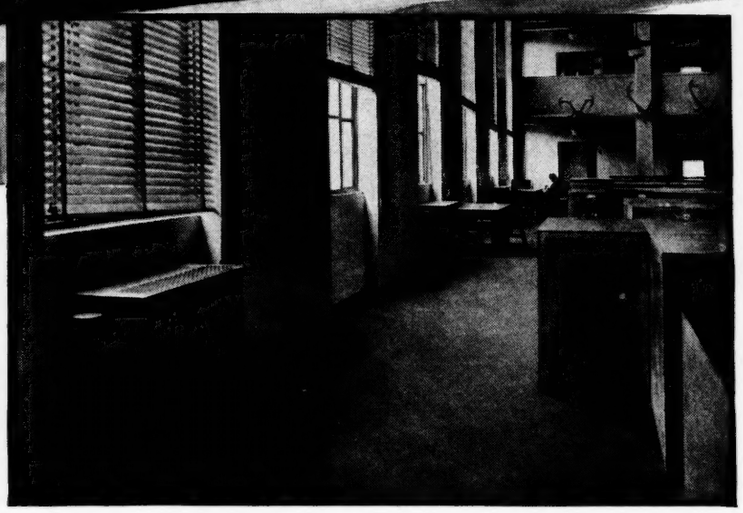
a mod-4

WEBSTER
MODERATOR
SYSTEM
OF STEAM HEATING
"Controlled by the weather"

SUPPLYING THE *Breath of Life*



Life Sciences Bldg., Univ. of California, Berkeley. *Architect*: G. W. Kelham, San Francisco. *Mech. Engrs.*: Hunter & Hudson, San Francisco. *Structural Engrs.*: H. J. Brunnier, San Francisco. *Builders*: Dinwiddie Const. Co., San Francisco. *Heating Contrs.*, Latourrette-Fical Co., Sacramento, Oakland.



...*in the* Life Sciences Building, University *of* California

IN this classic building, every facility and comfort has been provided to make the course of study more enjoyable, more beneficial and valuable to the student. Everything is the best...including the air! Stuffy, dusty rooms would be as much out of place as obsolete equipment and textbooks.

Libraries, laboratories and lecture rooms are free from the slow anaesthetic of bad air. Pure, invigorating air is continually circulating... noiselessly, without drafts. It's drawn in from outdoors, filtered clean, tempered to comfortable warmth when needed, and then passed gently into the rooms ...by Sturtevant Unit Heater-Ventilators. The units blend in quietly with the appointments. And the vents are concealed... nothing detracts from the dignity of the exterior.

Sturtevant Unit Heater-Ventilators are adaptable to an endless variety of installations in schools, churches, institutions, office buildings, etc. You will be interested in our Catalog 361. Our nearest office will send you one...for the asking.

B. F. STURTEVANT COMPANY
Main Offices: HYDE PARK, BOSTON, MASS. CHICAGO, ILL., 410 No. Michigan Ave., SAN FRANCISCO, CAL., 681 Market St.
Branch Offices in Principal Cities: Canadian Offices at: Toronto, Montreal and Galt. Canadian Representatives: Kipp Kelly, Ltd., Winnipeg. Agents in Principal Foreign Countries.

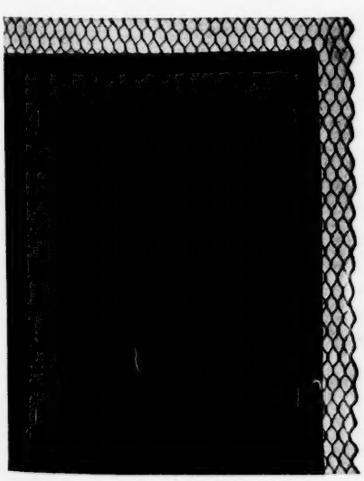
Sturtevant Unit Heater-Ventilator
Reg. U. S. Pat. Off.
SUPPLIES OUTDOOR AIR ~ FILTERED CLEAN ~ AND TEMPERED

THE GREATEST ADVANCE EVER MADE

BI-FLAX

COMBINING THE HIGH INSULATING VALUE OF FLAX-LI-NUM WITH THE PERMANENCE OF METAL LATH

PROTECTS AGAINST PLASTER CRACKS

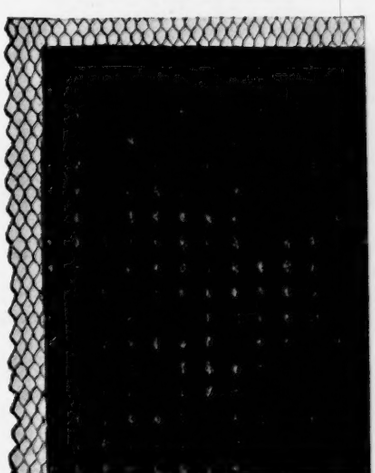


Until the development of BI-FLAX, no single material served the double purpose of thermal insulation and an ideal plaster base. BI-FLAX is an entirely new idea in insulating plaster bases. It combines the high insulating value of FLAX-LI-NUM with the permanence of diamond mesh metal lath . . . It protects against plaster cracks . . . It insulates against heat and cold.

Announced only a few months ago the acceptance of BI-FLAX was immediate and complete. It met exactly the demands of modern building for a new type of insulation. It builds life-long beauty and comfort into a home.

Architects and builders alike are enthused over its practical advantages . . . It is proof against plaster cracks . . . It deadens sound . . . It checks heat leakage. It is easy to apply . . . even to curved surfaces. It assures an adequate key without waste of plaster . . . . Complete information and specifications will be sent upon request.

INSULATES AGAINST HEAT AND COLD

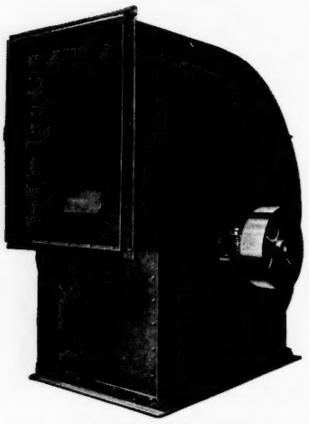


Product of

FLAX-LI-NUM INSULATING CO.

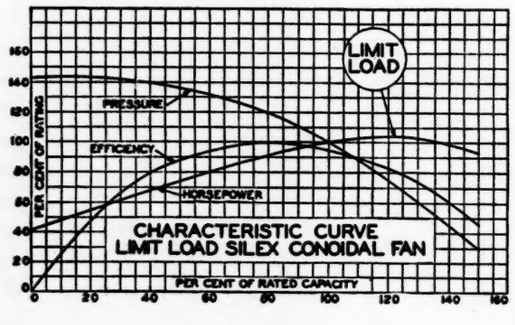
ST. PAUL, MINNESOTA

Now! the "Buffalo" "Limit-Load" Silex Conoidal Fans



"LIMIT-LOAD" SILEX FAN

Just as Buffalo was the first manufacturer to develop and build patented backward double-curved blade fans with fade-away power performance, (we have been selling them since 1915) so today Buffalo presents the "limit - load" Silex Conoidal ventilating fan with moderate speed and high efficiency. You can now pick your motors from the "Limit-Load" power data in our tables — and regardless of air delivery or pressure—your motors will not overload.



Now, when engineers specify "Limit-Load" Silex fans, in addition to stable air delivery, flat horsepower characteristic, good efficiency over a wide range of capacities and quiet operation, they have the security that comes with the knowledge that Limit-Load Silex fans will not overload their motors.

Buffalo Forge Company

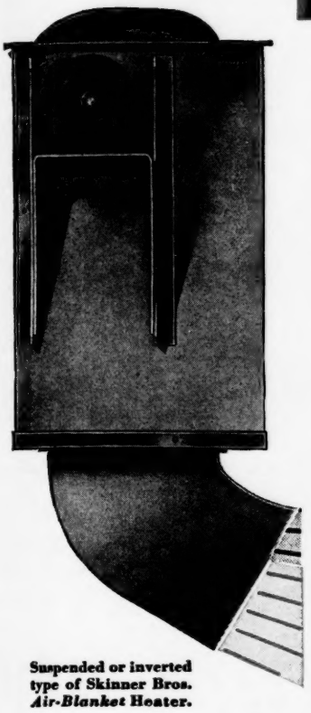
480 Broadway Buffalo, N. Y.

In Canada: Canadian Blower & Forge Co., Ltd., Kitchener, Ontario

"Buffalo" Ventilating Fans

"Backward Curved Blades for Fifteen Years"

A New Heating Method that Promises to Revolutionize Industrial Heating



Suspended or inverted type of Skinner Bros. *Air-Blanket* Heater.

For three years prior to its announcement, last month, the new Skinner Bros. *Airblanket* Method of Heating was put to exhaustive tests under actual working conditions. Then, when Skinner Bros. were fully satisfied that its use would spell new comfort, efficiency and economy in industrial heating, it was presented.

Although only one short month has passed since its introduction, Skinner Bros. *Airblanket* Method of Heating is the talk of architects, plant owners, engineers and contractors the country over.

Briefly, here's what Skinner Bros. *Airblanket* Method of Heating is: A method in which a blanket, or ceiling, of low temperature fast-moving air is projected horizontally over the breathing, or working, zone of an industrial building; thereby holding the warm air, which issues from a unit heater, down in the breathing zone, and enabling it to give off its warmth with less waste.

The full explanation of this remarkable new heating method is given in a booklet entitled: "Controlling Heat and Heating Cost with the *Airblanket*." Mail the coupon for your copy today.

AIRBLANKET
TRADE MARK

SEND COUPON FOR FREE BOOKLET

H&V-8

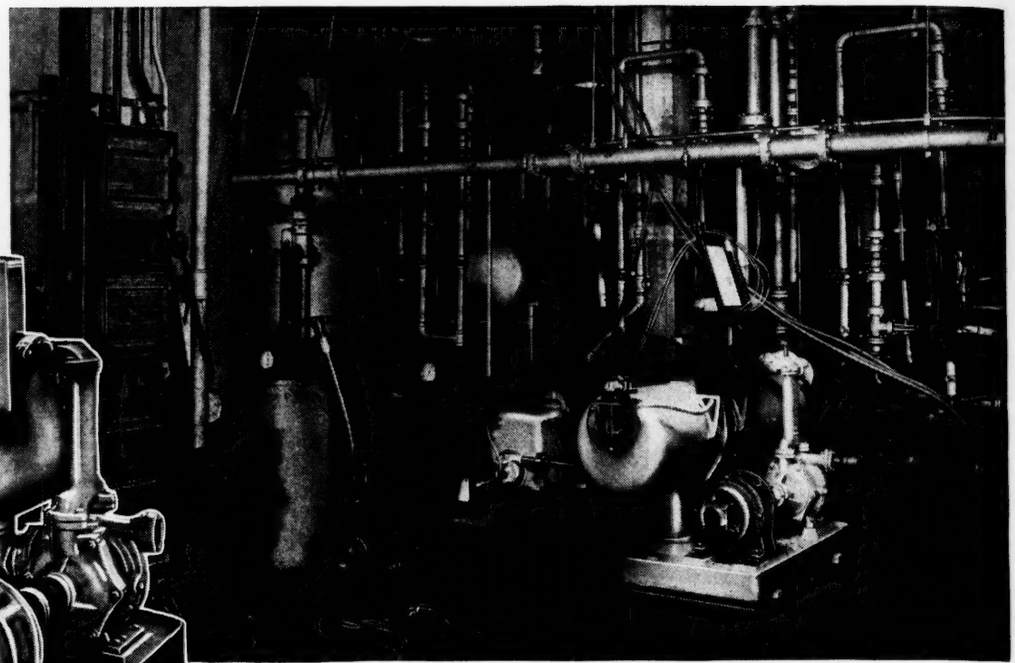
Name .....

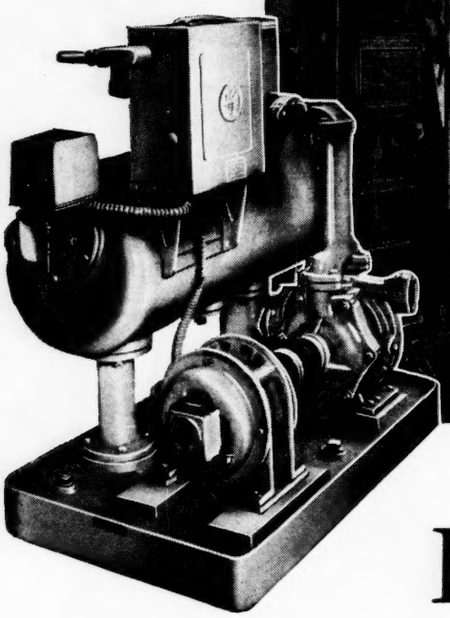
Address .....

City ..... State .....

SKINNER BROS. MFG. CO., INC.
1402 S. Vandeventer Ave., St. Louis, U.S.A.
"The Originators of Unit Heating"
Branches in All Principal Cities

Corner of laboratory in Nash Factory where every Jennings Pump is carefully tested.





Jennings Vacuum Heating Pumps are furnished in capacities of 4 to 400 g. p. m. of water, and 3 to 171 cu. ft. per min. of air. For serving up to 300,000 sq. ft. of equivalent direct radiation.

FACTORY TESTS *certify working capacity*

When the vacuum heating pump you install is a Jennings, it will handle the job. You can be sure of it.

Every Jennings Pump is carefully tested at the factory. Volumes of air and water simultaneously delivered under working conditions are determined. Horsepower required to deliver these quantities is checked. Each pump is tested with its own motor and control equipment.

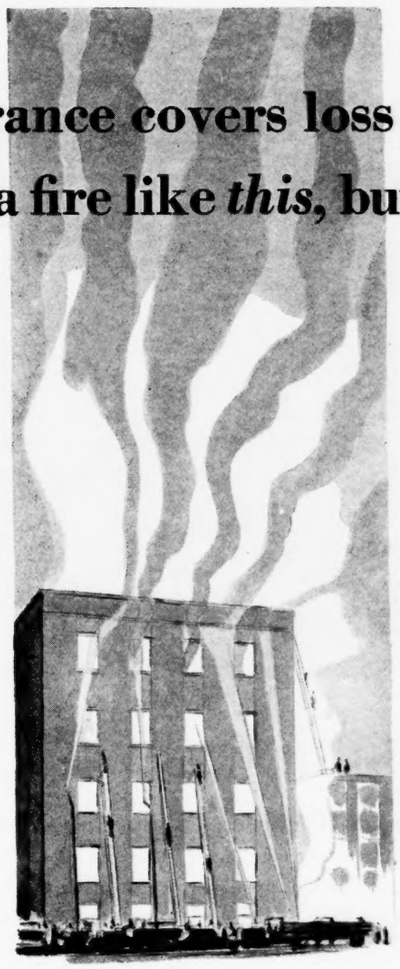
An unusual design provides several exclusive features. Air and water are handled by independent pumping units. The total capacity of the pump is the maximum capacity of the air unit plus the maximum capacity of the water unit. Since the returns separate in the receiving tank under vacuum, separation is accomplished more quickly. Also more thoroughly. Condensate is handled only once. Air is discharged direct to the atmosphere without back pressure.

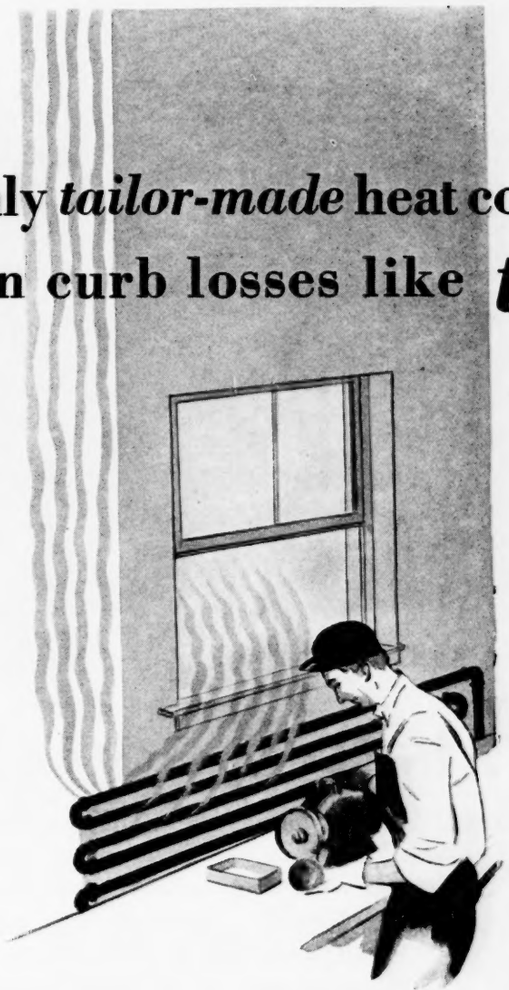
Bulletin 85 describes the design and operation of the Jennings Vacuum Heating Pump. Write for a copy.

The Nash Engineering Company, 81 Wilson Road, South Norwalk, Connecticut.

Jennings Pumps

Insurance covers loss from a fire like *this*, but only *tailor-made* heat control can curb losses like *this*



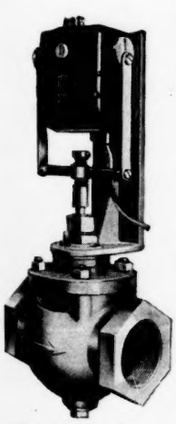


DANGERS that are obvious, we guard against. The insidious losses—subtle sorcerers that turn black figures into red ones—operate unseen. It is the reason heating engineers recommend and industrial executives approve of Minneapolis-Honeywell "tailor-made" systems of heat control. For these systems prevent waste by meeting the exact heat requirements of *each part* of *each plant*.

Such systems give 70 degrees in the offices—65 in the shops—55 in the warehouse—or any combination the plant requires. Applicable to radiators, pipe coils or unit heaters, individually or in groups. Insure comfortable working conditions. Increase plant productivity. Drastically cut fuel costs.

We gladly offer the co-operation of our engineering staff, without obligation. Will also send, free, a copy of our booklet, Unit Heater and Sectional Control Systems, on receipt of the coupon.

Clock Thermostat



Motorized Regulating Valve

Surface Aquastat

The coupon is there for your convenience.

MINNEAPOLIS-HONEYWELL REGULATOR COMPANY
2715 Fourth Ave. So., Minneapolis, Minn.

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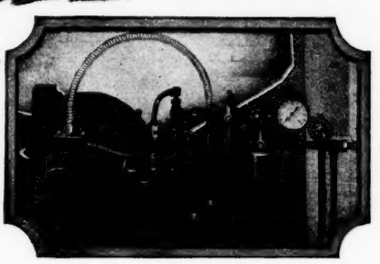
MINNEAPOLIS
INDUSTRIAL REGULATORS
HONEYWELL

Minneapolis-Honeywell Regulator Co., 2715 Fourth Ave. So., Minneapolis, Minn.
☐ Send me your pamphlet on Unit Heater and Sectional Control Systems.
☐ Have representative call. I understand there is no obligation.

Name..... *Position*.....
Company.....
Address.....
City..... *State*.....



Combining simplicity and sturdy construction with perfection of design and performance, the Johnson Oil Burner is an outstanding engineering achievement... the result of over twenty-five years' experience in the exclusive manufacture of oil burning equipment for every heating and power purpose.

His Reputation is Insured...

Reputation, says Daniel Webster, is confidence or character as established in public opinion .... The trade-mark *S. T. Johnson Co.* is reputation insurance . . . the sincere and reliable guarantee that the equipment upon which it is placed embodies all the latest improvements made possible by exhaustive research and over twenty-five years' experience in the exclusive manufacture and installation of oil burning equipment.

It is also your assurance of freedom from time or "profit-eating" service work . . . that the equipment you are selling will not be "orphaned" soon after you have sold it.

As the Johnson dealer, you also enjoy the advantage of selling a *complete* line of oil burning equipment to meet the heating and power requirements of every building in your territory.

There is a Johnson Oil Burner to meet the heating and power requirements of every building in your territory... from the smaliest residence to the largest public building, from the corner laundry to the 7-acre factory. There is no building too small nor no building too large for a Johnson installation.

With this *complete* line of oil burners, every part of town has profit possibilities... every month of the year is in season.

More prospects, greater profits... that's what is offered you with the Johnson franchise, *plus* the fullest factory co-operation in developing your territory, and access to the best engineering assistance the industry has to offer.

JOHNSON OIL BURNERS

Listed as Standard by the Underwriters Laboratories

Learn more about the opportunity the Johnson dealer enjoys to make money. Write for complete information, stating territory desired.

Manufactured and Guaranteed by

S. T. JOHNSON CO.

Executive Office and Factory: 940-950 Arlington Street, Oakland, California
Factory Branches: San Francisco, Sacramento, Stockton, Calif.; Philadelphia, Pa.

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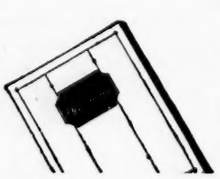
Member Oil Heating Institute

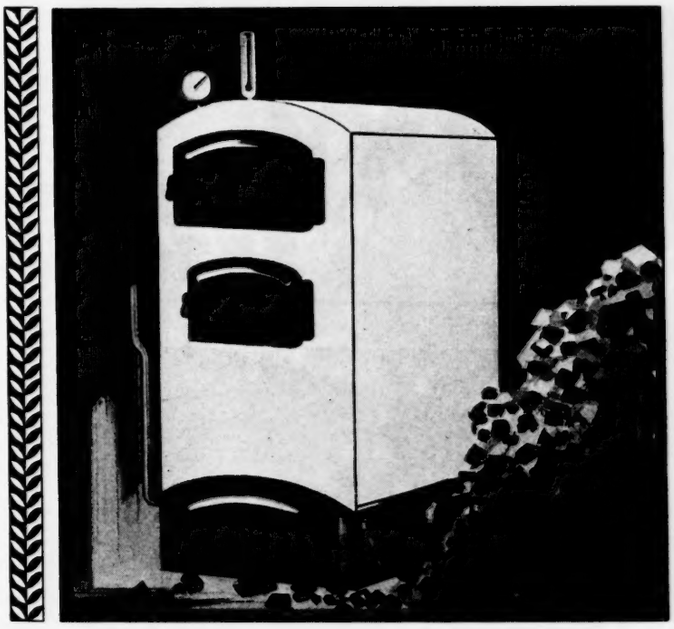


Send for this New Book... IT'S FREE!

"TODAY'S OPPORTUNITY" tells how you can build a profitable and substantial business. Shows why the Johnson franchise offers greater dealer profits. Mail this coupon now, and your copy will be sent without delay.

Name..... *Address*.....

City..... *State*.....



INSULATED BOILERS *Save* FUEL *and* LABOR

THAT insulation pays for itself in saved fuel and labor, is self-evident. And logically the higher the efficiency of that insulation, the more it will save.

When you combine highest efficiency, with ease of application, low original cost, permanence, and reclaimability, as found in Gimco Rock Wool "cut to fit" insulation, you most certainly have a sound investment.

Gimco Rock Wool Flexfelt, when installed on a boiler, will pay for itself in two months use.

Large Consumer Demand for Insulated Boilers

Boiler Manufacturers are urged to investigate the Gimco Rock Wool insulation as a means of increasing their sales. Consult us on boiler insulation problems. Our past experience in this field will be valuable to you.

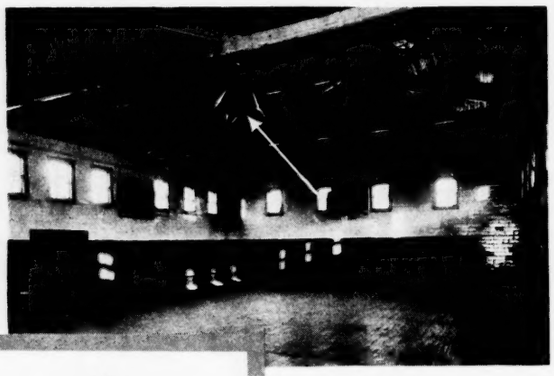
GENERAL INSULATING & MFG. CO.

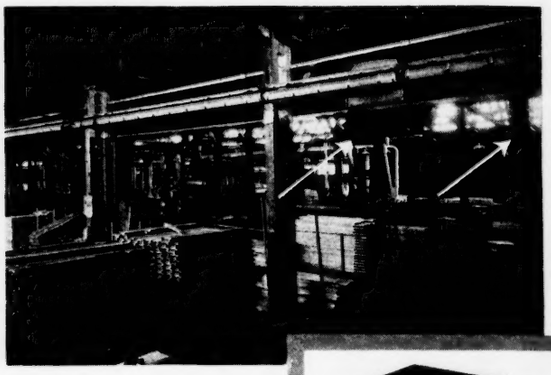
ALEXANDRIA, • • • INDIANA

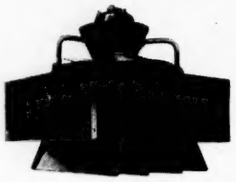
New York City Chicago Hollywood San Francisco Cleveland Houston Detroit St. Louis Pittsburgh Denver Toronto

The Modern Boiler Insulation

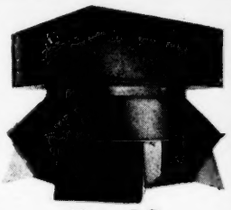
WING FEATHERWEIGHT







Type HC
Wing Featherweight Unit Heater.



Type LC
Wing Featherweight Unit Heater.

What Makes for Satisfaction in Industrial Heating?

THE great success of the Wing Featherweight Unit Heater has proved conclusively the correctness of Wing design and construction.

Thousands of letters from satisfied users of Wing heating systems emphasize the outstanding points of merit in this type of heater.

Adequate heat at the working level, out-of-the-way location of heaters, low fuel consumption and ease of control, are primary points to be considered in judging any heating system. Wing users are invariably satisfied on these points.

Our booklet "Some Basic Facts About Heating Industrial Plants" will give you the detailed reasons for this satisfaction. Send for a copy today.

L. J. Wing Mfg. Co.

Manufacturers of Wing-Scruplex Propeller Fans and Exhausters, Wing Featherweight Unit Heaters, Wing-Scruplex Fog Eliminators, Wing Type E M Motor Driven Blowers, Wing Turbine and Centrifugal Turbine Blowers, and Wing Steam Turbines.

Dept. 8, 158 W. 14th St., New York, N. Y.

"Heat with Unit Heaters"

"We are very much satisfied with the Wing Unit Heater which was installed in our machine shop approximately two years ago.

"Your heater has given us perfect satisfaction, and we believe that there is nothing like it for the money."

"We have had the Wing Featherweight Unit Heater operating in our plant for the past few years and have found it to give us a 100% service."

"We have obtained maximum heating efficiency in our building, which at all times during the past winter has been very comfortable."

"I think they are fine. It has increased temperature 20% on the old way. The Wing heater brings the temperature up in about 20 minutes in a cold room."

"We take great pleasure to inform you that the equipment is entirely satisfactory. We do not hesitate to call its performance 100% perfect."

"We have had uniform heat in all the buildings and have saved no small amount of fuel used over the old method that we formerly employed in heating this plant and the operation is so simple and so easily controlled that we are very glad to recommend the system very highly."

"The Wing Featherweight Unit Heaters installed in our various shops are giving entire satisfaction. We are able to maintain a uniform comfortable temperature during the depth of winter, and this despite the fact that the doors had to open frequently for receiving and shipping material."

"We are heating approximately 10,000 feet with two Wing Featherweight Unit Heaters, and in moderate weather do not have them running more than 50% of the time. We also derive considerable benefit in the summer months by running them to circulate the air."

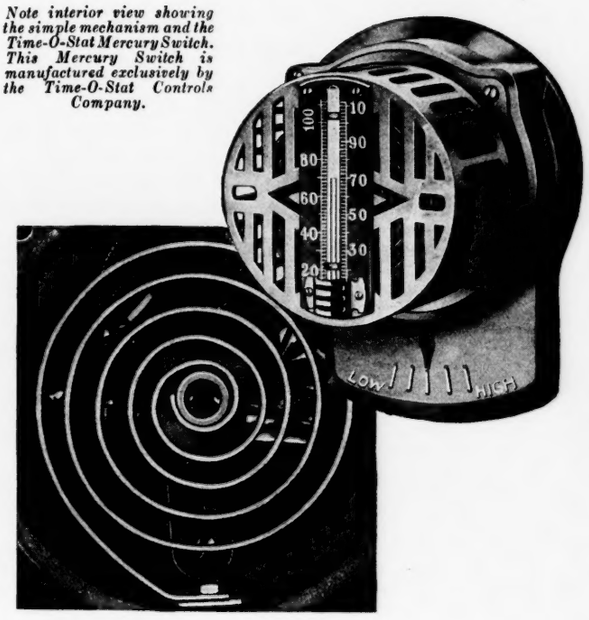
"We wish to advise that the Wing Featherweight Unit Heaters installed in our building are giving very satisfactory service, and form an essential part of the most modern and out of the way method of heating large spaces used for shop, garage, etc."

Names furnished on request.

UNIT HEATERS

TIME-O-STAT Controls have MERCURY SWITCHES *because . . .*

Note interior view showing the simple mechanism and the Time-O-Stat Mercury Switch. This Mercury Switch is manufactured exclusively by the Time-O-Stat Controls Company.



the switch is the heart of all electrically operated automatic controls and upon it depends the successful operation of the control. Time-O-Stat Mercury Switches are durable, dependable and positive in operation. Their high capacities and simple, sturdy construction assure reliable temperature control. Where Mercury Switches are used there is always a clean, positive switching action—free from arcing, pitting and corrosion—no complicated mechanisms demanding frequent adjustment.

The No. 135 Thermostat—at the left—is a sensitive, accurate room temperature control. It maintains room temperatures within a total variation of 2° F.

This thermostat is one of Time-O-Stat's complete line of mercury switch controls.

Send coupon for complete information on Time-O-Stat automatic controls with Mercury Switches.

TIME-O-STAT CONTROLS COMPANY

ELKHART, INDIANA

BRANCH OFFICES—NEW YORK, BOSTON, CHICAGO
EXPORT DEPARTMENT—NEW YORK
EXCLUSIVE DISTRIBUTORS IN ALL PRINCIPAL CITIES OF THE UNITED STATES
CANADIAN DISTRIBUTORS—TORONTO AND MONTREAL

Manufacturers of Automatic Controls for Oil Burners, Gas Burners, Coal Burners, Electrical Refrigerators, Furnace Fans, Mechanical Stokers, Industrial Ovens, Ice Machines, Unit Heaters, . . . also of Sign Flashers, Mercury Switches, Electric Heaters, Corrugated Metal Bellows.

Time-O-Stat Controls Company
Elkhart, Indiana Dept. No.....

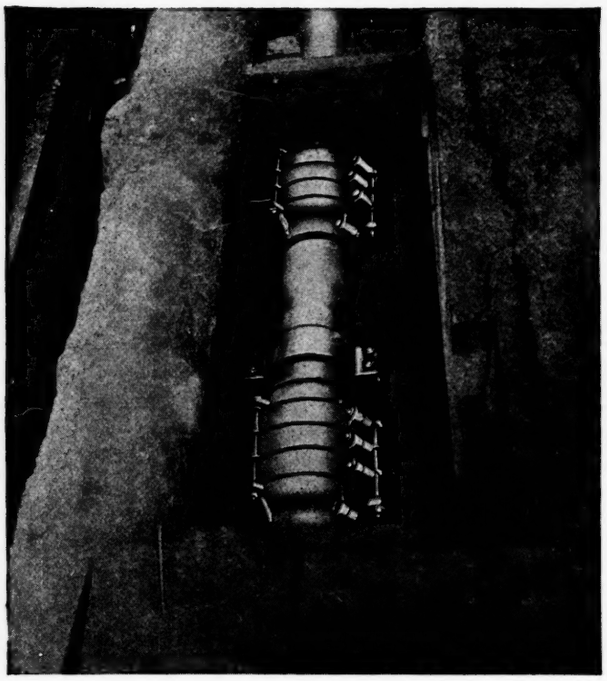
Without obligation on my part send me full information on Time-O-Stat automatic controls—with Mercury Switches.

Name.....

Address.....

Company.....

H-3

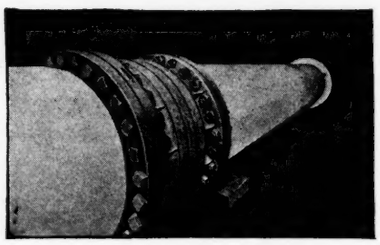


Cramped Quarters! Why they call for Badger Joints

IT'S bad enough installing an expansion joint in cramped quarters. It's even worse servicing the joint.

Badger Expansion Joints alleviate the former difficulty and eliminate the latter. They are very compact and are so designed that no packing is required.

These features are of value under all conditions but in cases where space is very limited or the line is difficult to get at, the need for Badger Joints stands out more strongly than ever.



BADGER EXPANSION JOINTS

E. B. BADGER & SONS COMPANY

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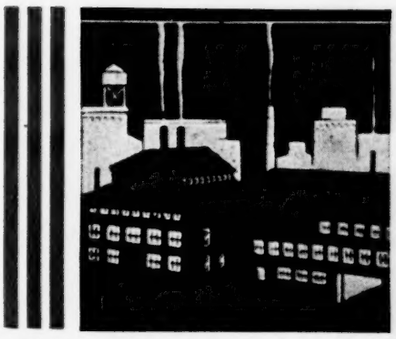
San Francisco, Cal., Sharon Bldg.
Seattle, Wash., 415 Lenora Street
St. Louis, Mo., 3605 Laclede Ave.



MASSACHUSETTS UNIT HEATERS

BETTER BUILT FOR BETTER SERVICE

UNIT heaters look quite similar but there is a big difference in design—and in performance. Check the following construction features of B & B Massachusetts Unit Heaters and you will know why they give universally satisfactory service.

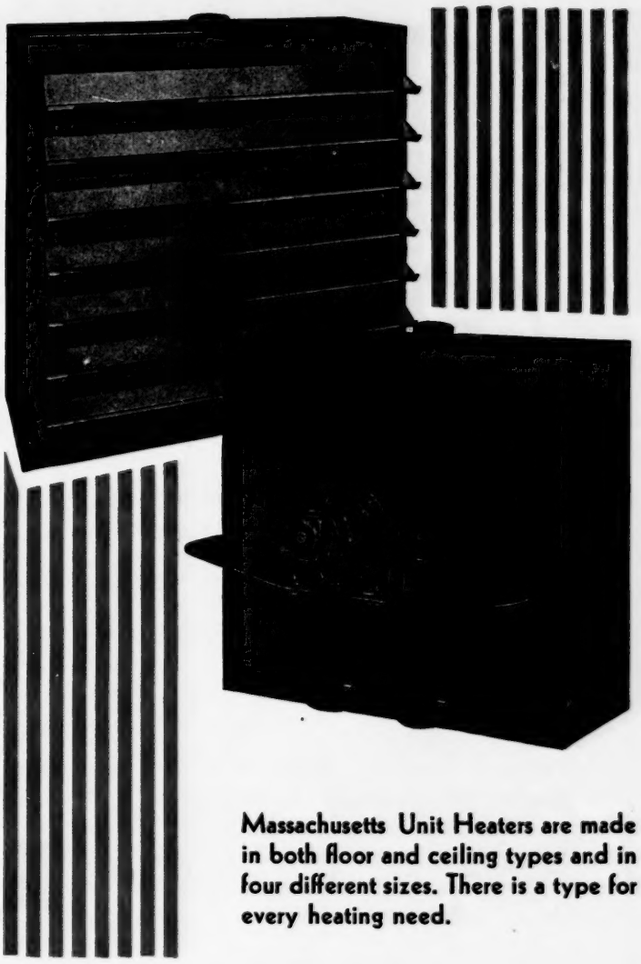
Heater casings—designed with an air space between the fan and heater section, insuring a uniform velocity over the entire heating surface, thus eliminating dead spots.

Propeller fans—produce larger and more uniform air displacement with lower power consumption and quieter operation.

Motors—standard makes, totally enclosed, rigidly mounted and automatically lubricated. Motors are large enough to run continuously without ventilation, insuring them against dust and fumes.

Heating coils—high pressure B & B copper fin radiation, providing maximum surface for heat transfer without undue air resistance. Heater sections are designed to operate on steam pressures up to 125 lbs. per square inch and are tested at 250 lbs. before being assembled.

May we send you our catalog, showing the complete line of B & B Massachusetts Unit Heaters?



Massachusetts Unit Heaters are made in both floor and ceiling types and in four different sizes. There is a type for every heating need.

The BISHOP & BABCOCK SALES COMPANY, Cleveland, O.

General Offices—4901-4915 Hamilton Avenue, N. E.

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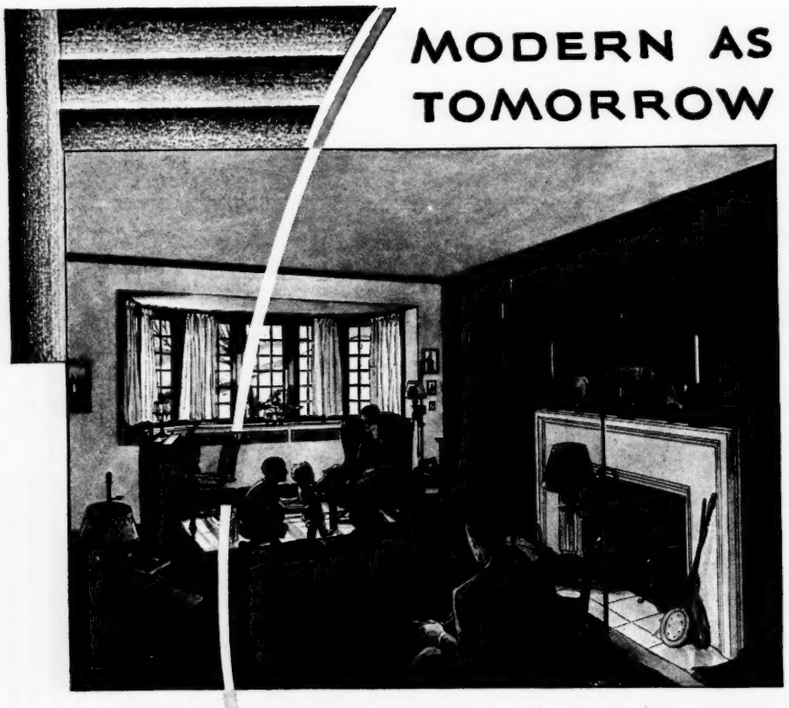


MODERN AS TOMORROW

MODINE

CONCEALED COPPER RADIATORS

Modern Modine Concealed Copper Radiators put heating in the walls, out of sight. They have proven that efficient, comfortable heating need not intrude the marring note of obviousness in modern construction.

Modines leave the impression of comfort and aesthetic good taste in room furnishing without imposing a consciousness of their presence.

—and, because Modine Concealed Radiators conform to tomorrow's ideas of heating, the room—equipped with Modines today—will retain the modern spirit and compete with tomorrow's on even terms.

Let us tell you how Modines look ahead—how they meet tomorrow's standards. Send for our new book "Modern Modine."

MODINE MANUFACTURING COMPANY

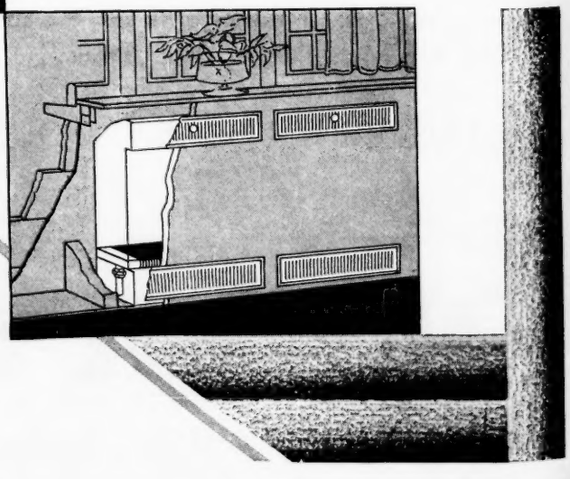
Manufacturers of Unit Heaters, Domestic Copper Radiators, Automotive Radiators

1707 RACINE STREET RACINE, WIS.

New York Show Room, Architect's Bldg., 101 Park Ave.

London Office: S. G. Leach & Co. Ltd., 26-30 Artillery Lane

A MODINE Product



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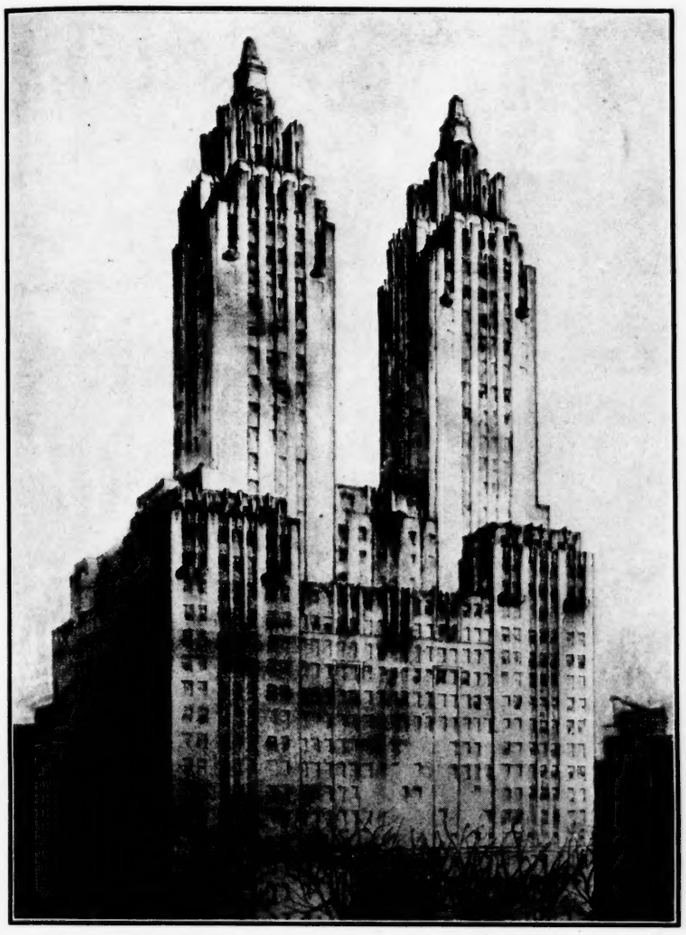

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CLARK, MCMULLEN & RILEY
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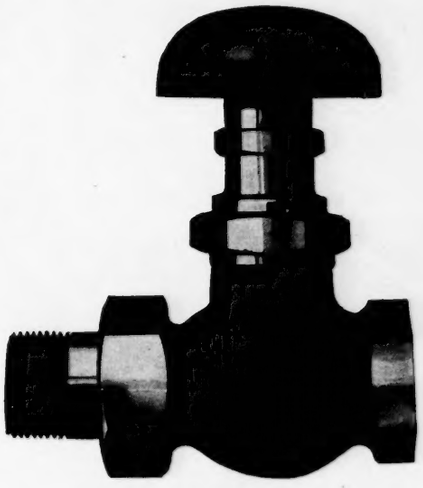
RAISLER HEATING CO.
Heating Contractors

MARSH CONE DISC PACKLESS VALVES

Fig. 241

used throughout on this job



Cone Disc Packless Fig. 241

MARSH VALVE COMPANY

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SARCO COMPANY, Inc.
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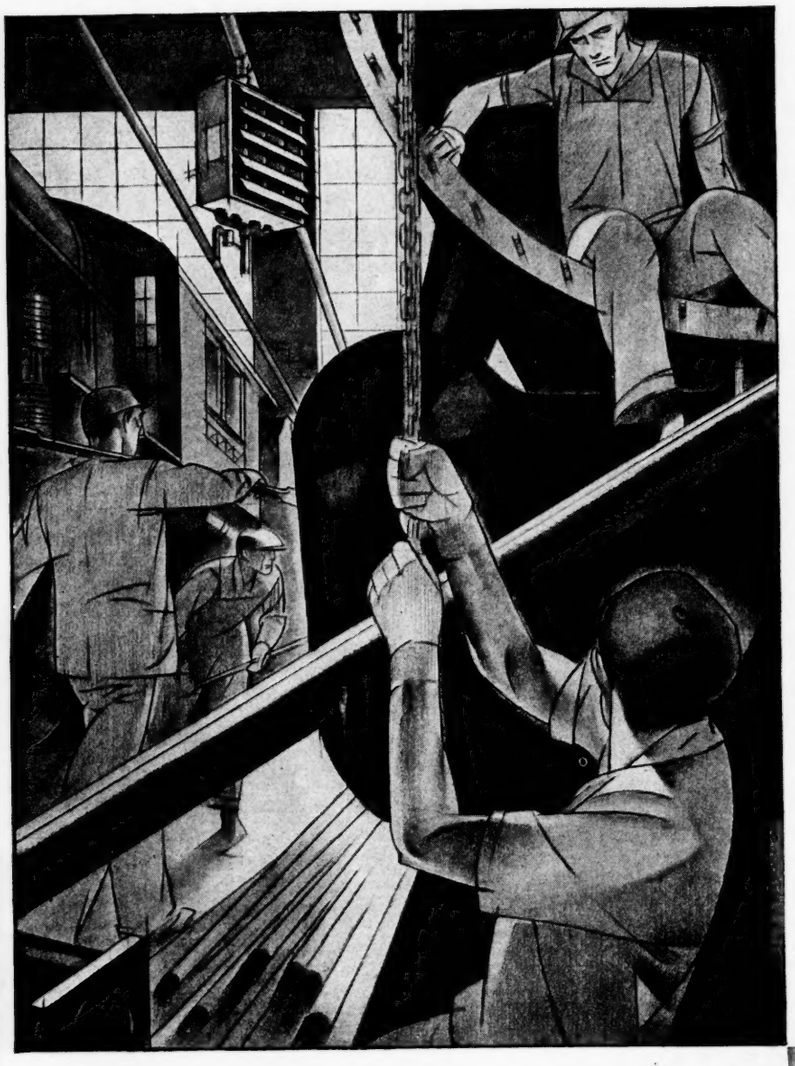
Worry-free heating results . . .

your customers expect them—hiJet *assures them*



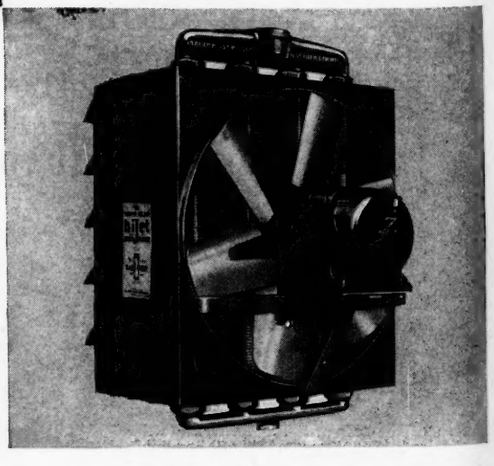
"WILL the job stand up?" That's the question many buyers of heating equipment are asking today. The heating contractor who installs Herman Nelson hiJet Heaters can answer that question sincerely and quickly by saying, "Yes—absolutely."

The hiJet's heating element is the Herman Nelson Radiator which has no brazed, welded, soldered or expanded joints to fail and leak. It is rust-proof and will safely withstand any expansion or contraction strains. It is guaranteed for operating steam pressures up to 150 pounds. A specially designed, finely built motor—the Her-Nel-Co—permits simple speed control with minimum running current.

In operation, the hiJet directs a high velocity vertical jet of warm air downward, dispelling the cold air strata at the floor line and heating the areas where heat is required.

For profitable installations, free from call-backs, select the Herman Nelson hiJet Heater. It comes in three sizes—all easy to install. Write for our hiJet catalogue.

THE HERMAN NELSON CORPORATION, MOLINE, ILLINOIS



The HERMAN NELSON

hiJet

TRADE MARK

HEATER

For the economical distribution of heat in Factories, Railroad Shops, Roundhouses, Warehouses, Mills, Garages, Gymnasiums, and all industrial buildings, as well as in special process rooms where uniform heat maintenance is required.

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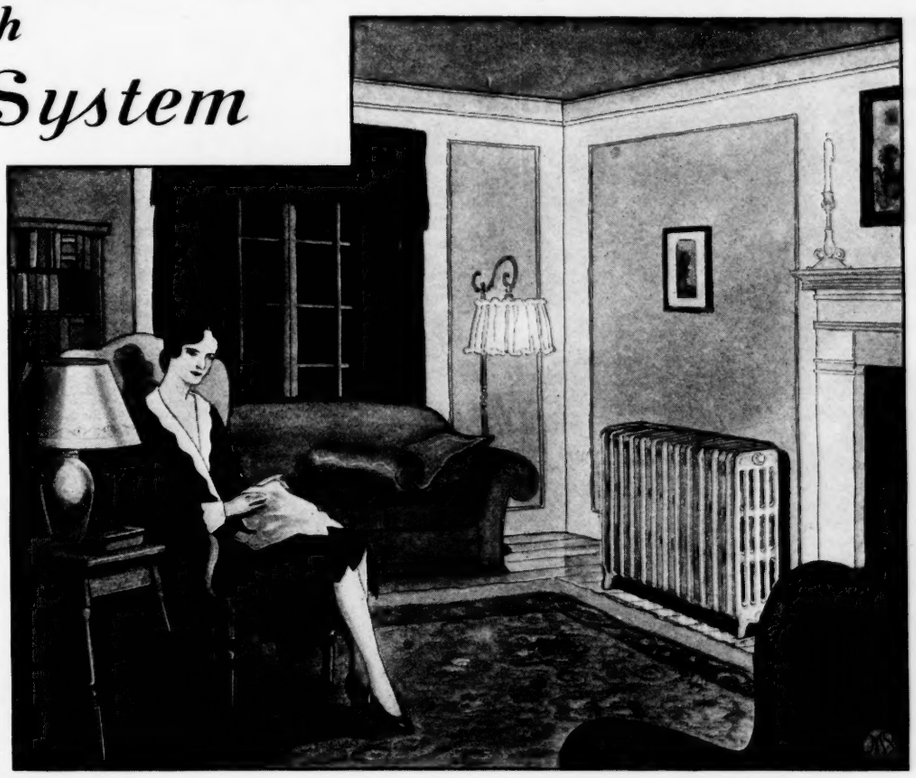
HEALTHFUL HOT WATER HEAT
with
Thrush System

Automatic Operation

Even Distribution of Heat

Fuel Economy



The Thrush Differential Pressure Relief Valve
(GUARANTEES SAFETY)

Here's what THRUSH SYSTEM offers .... Fewer Doctor Bills .... Less Fuel Cost .... Automatic Operation .... Added Comfort .... Absolute safety. And, the first cost is negligible—reduction in pipe sizes oftentimes offsets the cost of THRUSH SYSTEM.

Write today for our new catalog. It is *"chuck full"* of valuable data. *Address*

H. A. THRUSH & CO.
PERU, INDIANA

THRUSH SYSTEM
Of Hot Water Heating

90% of Baldor Users Repeat!

IT is highly significant that of the many firms which have ever bought Baldor Ball Bearing Motors, 90% are still active customers.

Only one thing could bind such a high percentage of users in so many different fields so continously to a product. That thing is Baldor performance . . . one important feature of which is the ability of Baldor ball bearing motors to completely eliminate the thrust and lubrication problems of the sleeve bearing type motors.

Naturally, firms which recognize the practically trouble-proof quality of ball bearing motors look to Baldor—who has always specialized in ball bearing designed motors and who has had 10 years time in which to perfect the Baldor Ball Bearing motor line.

Windings for all current characteristics. Ask for folder. Baldor Electric Co., 4356 G Duncan Av., St. Louis, Mo. U.S.A.

BALDOR

A BETTER BALL BEARING MOTOR

Eliminates Thrust and Lubrication Problems

How many men do you HAVE to see when you buy insulation?

.... ONLY ONE!

WHEN you are busy and the important problem of purchasing insulation comes before you it saves time to talk to one man who is prepared to discuss intelligently *every* form of insulation to meet every need.

When a J-M sales engineer calls on you he is fully prepared and thoroughly equipped to assist you in any problem which may confront you on insulation. He represents an organization which for seventy years has been the leading authority on industrial insulations. He can offer you insulation in any form and combination whether it be block, brick, plaster or filler to meet your insulation needs and to cover every temperature range from the lowest to the highest. He has no particular type of insulation to push in preference to any other. His one idea is to give you an insulation job that will prove the most satisfactory and that will save the most money for you.

The J-M representative has available for your use facts, figures and vitally important data that seldom get into print. He brings to your particular problems an engineering experience and understanding that should be helpful to you. And if your insulation needs are special or unusual his assistance in putting your problems clearly before our engineering department is well worth the time you give him.

JM PRODUCTS

Johns-Manville

INDUSTRIAL INSULATIONS

INCLUDING SUPEREX, SIL-O-CEL, 85% MAGNESIA, SPONGE FELT, ROCK CORK
For all temperatures from 400° F. below zero to the highest industrial temperatures

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Please have a J-M representative call to discuss Insulation in our plant.

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Only the ...

BAYLEY Chinookfin Heater has

This Unique *"Tube within a Tube"* Principle!

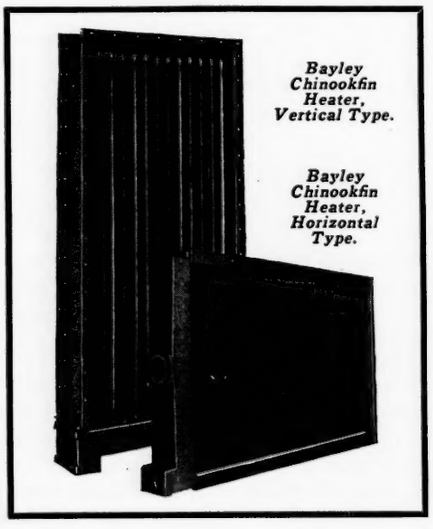
MORE than fifteen years ago Bayley perfected a unique type of indirect heater, under the trade name of Chinook. It possesses remarkable features; a single header divided into steam and return chambers, individual radiating tubes with individual feed through individual circulating pipes, no return bends, elbows or rigid connections of any kind to be racked out of shape by expansion and contraction . . . no air lock, no steam hammer . . . a heater which remains sound and tight under all steam pressures and constant thermal changes, because of its "tube within a tube" method of construction.

Copper Radiating Element

These remarkable advantages incorporated in a copper fin radiating element are offered in the latest Bayley indirect heater — the Chinookfin. The merits of copper fin extended surfaces for rapid heat transfer are known and accepted; the Bayley Chinookfin embodies this virtue in addition to its unique and original Bayley Chinook construction advantages.

Safe for Tempering Coil Service

The "tube within a tube" principle of construction protects the Bayley Chinookfin Heater against freezing even when sub-zero air is passed over its surfaces. It is the only indirect heater which is wholly as safe for tempering coil service as for reheating.



Bayley Chinookfin Heater, Vertical Type.

Bayley Chinookfin Heater, Horizontal Type.

For engineer or executive who has the responsibility of selecting or specifying indirect heaters for heating, ventilating, air conditioning systems, process drying, tempering coil, or other service, the Bayley Chinookfin Heater solves many a difficulty.

• • •

The unique and original Bayley "tube within a tube" method of indirect heater construction, as applied in the Chinookfin Heater, is fully explained in Bulletin No. 29-C.

May we send a copy?

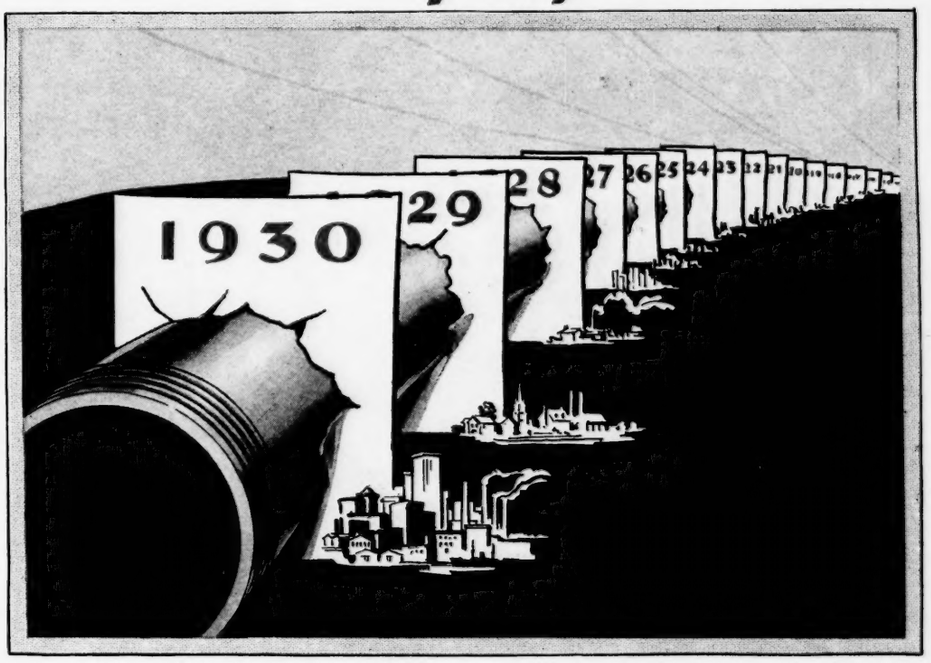
BAYLEY BLOWER COMPANY, *742 Greenbush St., Milwaukee, Wis.*

Fans — Heaters — Air Washers — Unit Heaters — Heating, Ventilating, Drying, Air Conditioning, Humidity Control, Mechanical Draft.

Bayley

CHINOOKFIN HEATERS

YEAR IN . . YEAR OUT
Every Foot *performing*



and workmen prefer using it

Down through the mist of years, the superior qualities of "Spang" Welded Steel Pipe have established an enviable reputation surpassed by none—many milestones of progressive pipe manufacture have been passed by this pioneer organization—and today as of yesterday "Spang" Welded Steel Pipe is recognized by master plumbers the nation over as the pinnacle of pipe perfection.

Specify "Spang"—it is the shortest, surest cut to QUALITY in plumbing or heating pipe.

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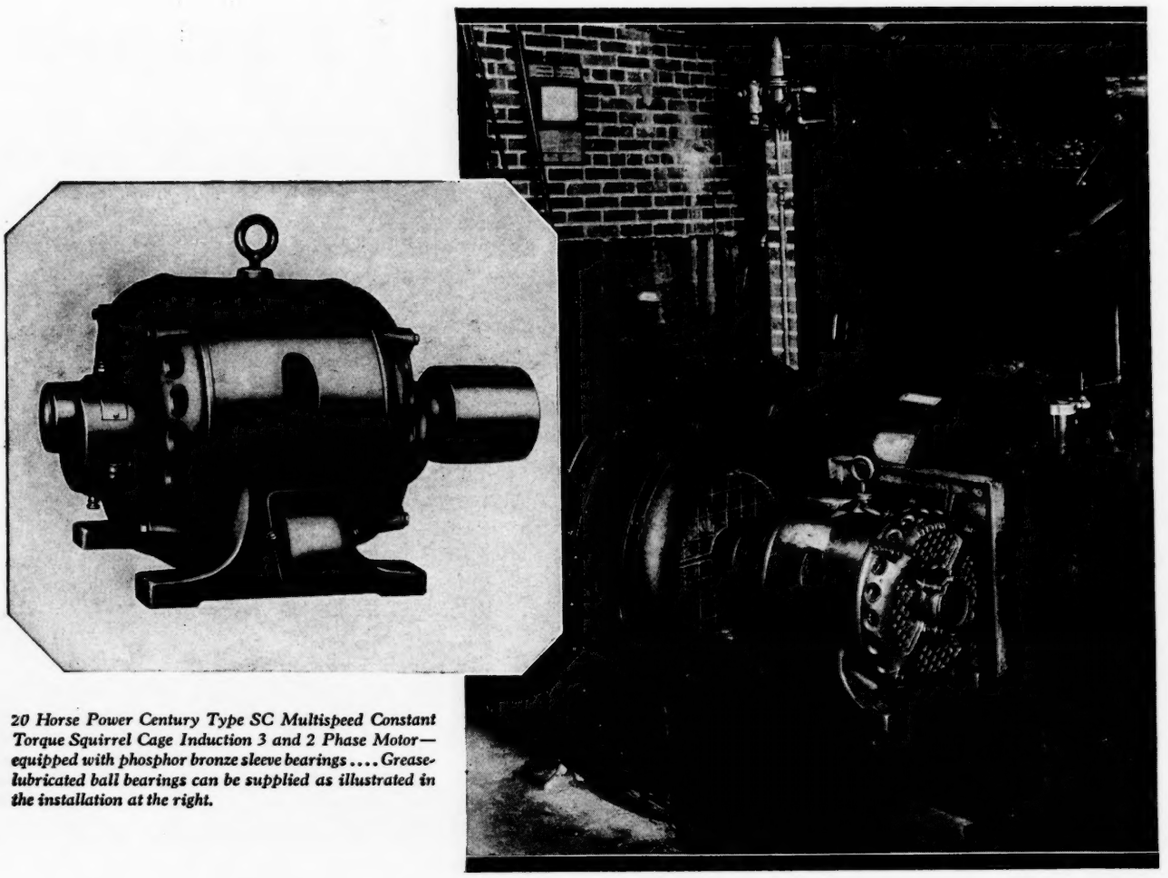
SPANG
WELDED STEEL PIPE



20 Horse Power Century Type SC Multispeed Constant Torque Squirrel Cage Induction 3 and 2 Phase Motor—equipped with phosphor bronze sleeve bearings.... Grease-lubricated ball bearings can be supplied as illustrated in the installation at the right.

MULTISPEED MOTORS

CONSTANT HORSE POWER
CONSTANT TORQUE.....VARIABLE TORQUE

The operating economy of Century Type SC Multispeed Squirrel Cage Induction 3 and 2 Phase Motors is due to their power demand being in direct ratio to the horse power rating at a given speed....This makes them particularly desirable in all installations where lower operating cost is a factor or where adjustable speed requirements must be met—as in blowers, fans, machine tools, wood-working machinery and similar apparatus.

They are built regularly for 2, 3 and 4 speeds with wide or narrow speed ranges, such as 1800/1200 or 1800/600 down to 900/450 r. p. m. (60 cycle). Special speed combinations are available.

Built in standard sizes from 1/4 to 125 horse power, also in normal torque, high torque and normal or low starting current types.

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1806 PINE ST. • • ST. LOUIS, MO.
40 U. S. and Canadian Stock Points and More Than 75 Outside Thereof

SINGLE PHASE, THREE PHASE, AND DIRECT CURRENT MOTORS

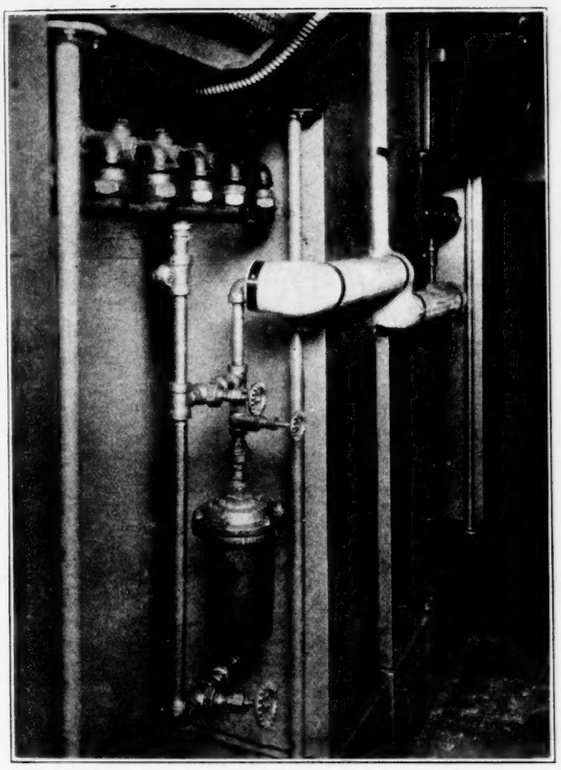
Century MOTORS

MOTOR GENERATOR SETS, ROTARY CONVERTORS, FANS AND VENTILATORS

641A

FOR MORE THAN 26 YEARS AT ST. LOUIS

UNIT HEATER BUYERS *are not trap doctors*



Armstrong Traps draining unit heaters in the Pullman Laundry, St. Louis, Mo.

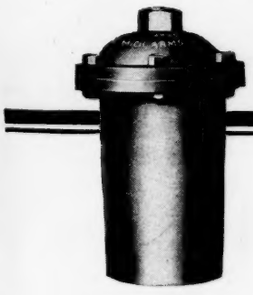
Provide them with Armstrong inverted bucket traps for attentionless service . . . .

ARMSTRONG steam traps keep unit heaters automatically drained of condensate, yet require practically no attention. They cannot air-bind; air, gases and sludges are discharged with the condensate. The upward swirling motion of the water makes them self-scrubbing.

They have capacities greater than most traps of much larger size, yet are small enough to be supported by connecting pipes.

Detailed information as to their operation and application available on request. We are also glad to cooperate with engineers and architects in determining the proper sizes of traps on heating jobs, without obligation.

No. 3 Armstrong Trap, one of the sizes widely used on unit heaters.



ARMSTRONG
MACHINE WORKS
Three Rivers, Mich.
District Representatives in 42 Cities

ARMSTRONG "INVERTED BUCKET" STEAM TRAP

H&V8-Gray

11¢ Per Square Foot of Radiation with Oil

Another Heggie-Simplex record for fuel economy was established in the past season in heating the new Tower Building, Washington, D. C. Although two Heggie-Simplex Steel Boilers were installed (of a combined rating equal to that ordinarily specified for a building of this type) only one boiler was needed to efficiently heat the building with its 22,000 square feet of radiation. *It did this, with oil, at the very low cost of 11c per square foot of radiation per season!*

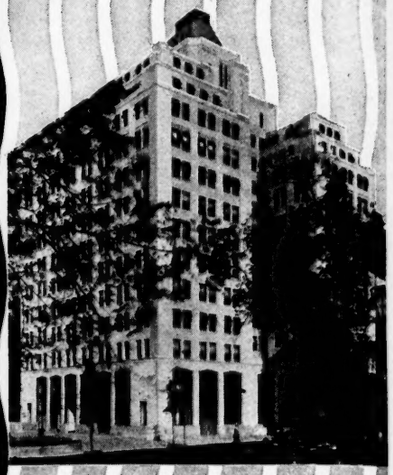
Heggie-Simplex Steel Boilers pay for themselves quickly in fuel saving alone, because their construction assures complete combustion and complete utilization of heat units.

The extra large fire box gives fuel—oil, gas, coal, or coke—more room to burn. More of the heating surface is in direct contact with the fire; thus heat units are absorbed faster. Unrestricted circulation of the water carries the heat to the outlet without waste. "Rear-front-rear" flues strip the gases of all usable heat units before they reach the chimney.

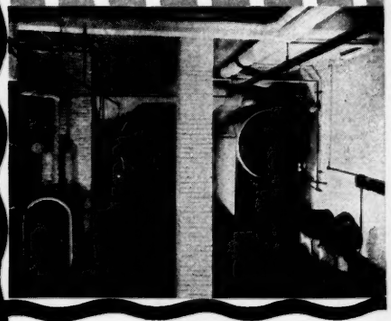
Built of steel, electrically welded into one seamless unit, Heggie-Simplex Boilers are *crack proof* and leak proof. No shutdowns! No costly repairs! Because of this sturdier construction, insurance and maintenance charges as well as *fuel costs* are exceptionally low.

For complete facts, write Heggie-Simplex Boiler Co., Joliet, Ill. Representatives in principal cities—'phone listed under "Heggie-Simplex Boilers."

MEMBER OF THE STEEL HEATING BOILER INSTITUTE



Tower Building, Washington, D. C.
Architect—Robert F. Beresford
Heating Engineer—Robert Mayo, Jr.
Heating Contractor—Isadore Freund
Illustration below—Heggie Simplex Boilers and Refuse Burning Water Heater installed in this building.



HEGGIE-SIMPLEX
STEEL HEATING BOILERS

HEATING AND VENTILATING

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The Heating and Ventilating Magazine

Contents of previous issues of HEATING AND VENTILATING *can be found by consulting the Industrial Arts Index at the nearest library.*

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Editorial

Committee Of Ten

IT is evident that in the formation of the "Committee of Ten—Coal and Heating Industries" and in its announced objects the solid fuel interests are being guided by a careful analysis of their problems. It has long been known that both coal operators and dealers were devising ways and means to combat the challenge which threatens their leadership in the heating field, for there is no discounting the fact that 50,000,000 tons of anthracite and 70,000,000 tons of soft coal are consumed annually in the heating of buildings.

While the Committee of Ten is "to serve the public more efficiently by promoting heating satisfaction with solid fuels," the way in which they propose to attain their object is what makes the announcement especially interesting. The plan involves systematic contacts in various localities between coal merchants, dealers in heating and ventilating equipment and heating contractors. Besides the promotion of automatic heat with coal and the servicing of complaints, it is proposed to set up and enforce local standards and to conduct publicity campaigns in the local newspapers and otherwise.

Represented in the association are organized groups of operators, coal dealers, heating contractors, sheet-metal contractors, as well as manufacturers of boilers, warm-air furnaces and accessories. It will be a job to weld together the activities of so many groups, but at least the coal men are smart enough to realize that they won't get to "first base" without the cooperation of the heating men.

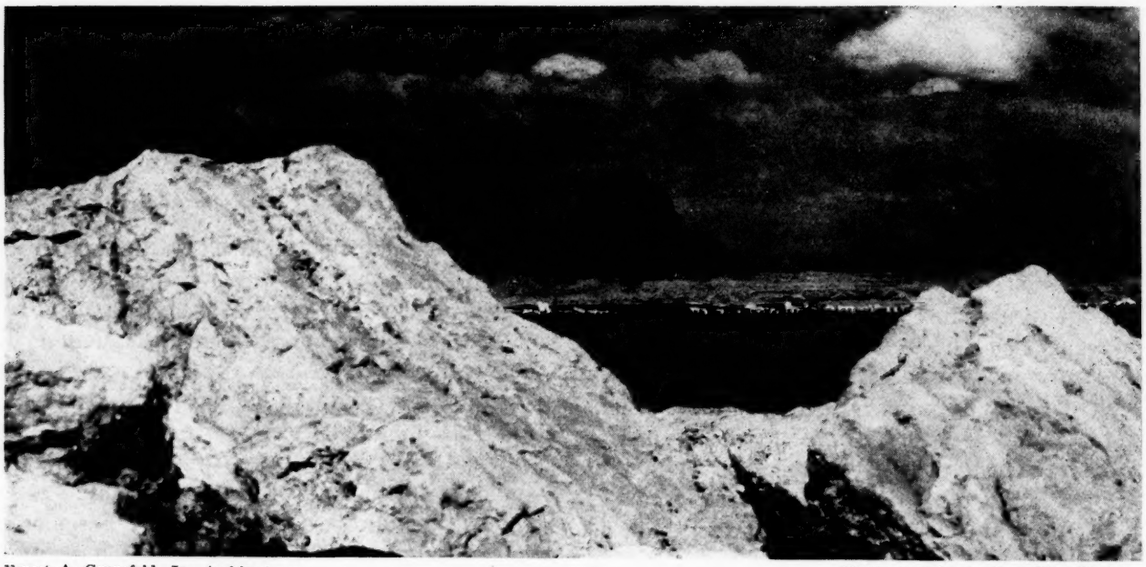
Association Loyalty

THERE has been no finer display of association loyalty than that shown by members of the Heating and Piping Contractors National Association when they learned that the expenditures for the year were considerably in excess of income. As was stated at the time, the unusual outgo was planned deliberately by the board as justified by the expansion of the association's activities.

Then, if ever, was the time for the rank and file to arise in their wrath and flay the administration. However, they did nothing of the sort. They realized how much was involved in the adventure the association was conducting through its enlarged program. During a tense moment of the convention the keynote was sounded by a member of the Chicago local association who gained the floor to state that his organization was prepared to pledge $10 per member towards wiping out the deficit. In less time, almost, than it takes to tell it, twelve local associations had made similar pledges. Before the session was over what had appeared to be a cloud hanging over the association as it began its new year dissolved into thin air. To cap the climax, the convention thereupon reelected its president for his third successive term.

The Heating Contracting Field

A CONVINCING confirmation of the statement expressed more than once by HEATING AND VENTILATING regarding the number of worthwhile heating contractors in the United States is contained in the figures presented at the annual convention of the H. & P.C.N.A. giving the results of a survey of the business of 100 representative heating contractors. It was brought out in the survey that of this number 15 reported sales under $40,000, 15 had sales between $40,000 and $80,000, 20 had sales between $80,000 and $150,000, 31 had sales between $150,000 and $300,000, while 19 had sales over $300,000. The average business of these firms was stated to be $231,698. To many this figure will appear rather high, but accepting it as it stands, and taking 7% of the total construction cost in 1929, the percentage arrived at in the H. & P.C.N.A. survey, as representing the amount spent for heating and ventilating equipment, we come to the interesting conclusion that 7% of $7,000,000,000 (total building construction cost for 1929) equals $490,000,000 (total amount spent for heating and ventilation) and that this amount divided by $231,698 (average volume of business of each contractor) equals 2100 as the number of important heating contractors in the United States. Admitting that the average of $231,698 should be modified, any lower figure would only tend to confirm our estimate that less than 5600 contractors at most are doing the bulk of the heating and ventilating business in this country.



Ernest A. Grunsfeld, Jr., Architect — Martin C. Schwab, Consulting Engineer

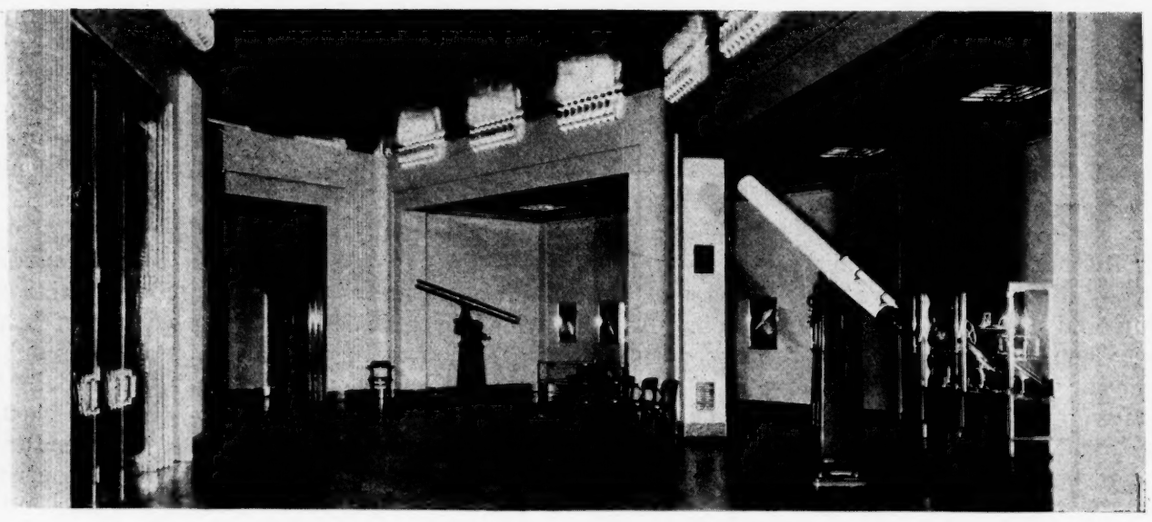
The Chicago Planetarium, Showing Its Setting on Lake Michigan

Chicago's Planetarium

CHICAGO'S new Planetarium, a gift to the city from Max Adler, is essentially an engineering building, designed for the single purpose of housing an interesting and unique machine. While recognizing the potentialities of its location upon an island site similar to that of a lighthouse promontory, Ernest A. Grunsfeld, architect of the building, fearlessly has cast aside even the slightest reference to earlier architectural symbolism. He has erected a severely simple structure, absolutely symmetrical of outline, whose hard-finished, dark polished surfaces stand out in impressive contrast to the white classical outlines of other civic buildings near by the planetarium. Even the copper dome is stained, so that the building silhouette seems actually to be pulled out of space against the lake and sky.

The inside walls are very flat. Gold surfacing above gives a glow like natural light—solid metals highly polished seem translucent, too. Brass, white metal, chromium, silver in luminous panels or suspended lights enhance the perfused light.

Chicago's planetarium and those to be built in Philadelphia and in Moscow complete the list of these glorified magic lanterns capable of picturing the complex movement of 5400 stars in the universe and the milky way in their true and varied courses, so that in four minutes we observe an entire day; with universe



How Concealed Radiation Harmonizes with Architectural Design of Planetarium Chamber Floor

upended we can see the southern polar sky or turn time back or forward. We escape from our present bounds and see the sky 10,000 years ago or far enough ahead for the Southern Cross to dominate Chicago's sky as does occur in cycles requiring 26,000 years actually to complete.

Martin C. Schwab, consulting engineer on the project, demonstrates what ingenuity in design may be imposed by the uncompromising directness of a modernist design. The apparent simplicity is deceptive. Panel lights of the exhibit chamber are encompassed by parallel bars of brass which fulfill the artist's ideal for visual limits of the light. The engineer uses these bars as grilles to conceal four-way air inlets to the space below.

Exhaust ducts open near the floor on inside walls. These duct grilles, too, relate to illuminated transparencies above each opening.

The building is a dome within a dome—the outer one of copper. A complex mass of steel beneath, with ever-finer labyrinthine structural supports, permits the firm and secure anchorage of the immense white canvas of the inner dome which serves as the projection screen for the glorified magic lantern show displayed.

This inter-space between the domes and the four stairways carries the only cast-iron radiation within the building. Concealed radiators are used elsewhere either on columns or under windows.

Planetarium and Chambers Ventilated Separately

There are separate ventilating systems for planetarium and exhibit chambers. An independent unit heating system at the entrance door circulates the air at suitable pressure to overcome incoming drafts from open doors. Toilets and certain service rooms are on separate air supply circuits.

Air inlets and exhaust are open on side walls at the level of the top story. Nice calculations have been employed here to allow for landward winds and to make up any difference that may appear because the contour of the monument could not be marred by any penthouse for fans.

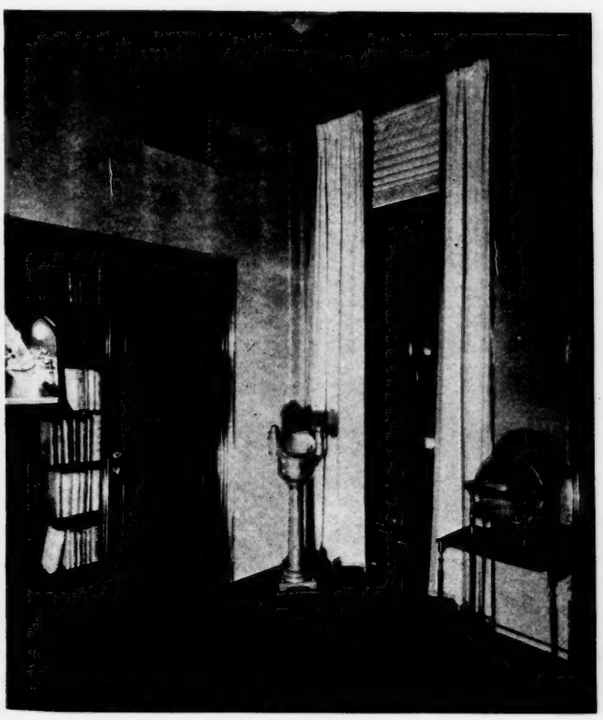
The height of inlet duct and its location on the lakeside frontage protects against introduction of surface dust. Exhaust opening is in the opposite side, as far as possible from the intake air.

Air dustiness within the planetarium chamber would carry an added menace in the wholly-enclosed space, and the canvas would be spoiled by clinging dusts. This explains why water-washed air is subjected to still further purification by passing through a series of automatically-controlled, self-cleaning viscous oil filters before it is heated and sent through the rooms.

The exhibit room, so large as never to be subject to overcrowding, is provided with four cycles of air change per hour. The library has five changes. Air calculations for the planetarium chamber, the central, windowless room before described, has been on a basis of 10 sq. ft. of floor space per spectator, and for 1500 cu. ft. per hr. of air per person in the room that has a maximum capacity of 400 persons.

The spring of the canvas dome begins at a point 8 ft. above the floor. A panoramic cut-out of white metal reproduces around the chamber in reduced scale Chicago's actual skyline with the monumental-like planetarium as a center and the Stevens Hotel to mark the limits of the circle of vision. Three louvres all the way around the room below this line make a vivid black limbo into which the stars may sink.

The lower space between the double walls that enclose the planetarium chamber has been used as a means for absolute concealment of



Corner of Museum Section, Showing Radiator Grille

Another View on Planetarium Chamber Floor Showing Concealed Radiation at Extreme Left and in Column

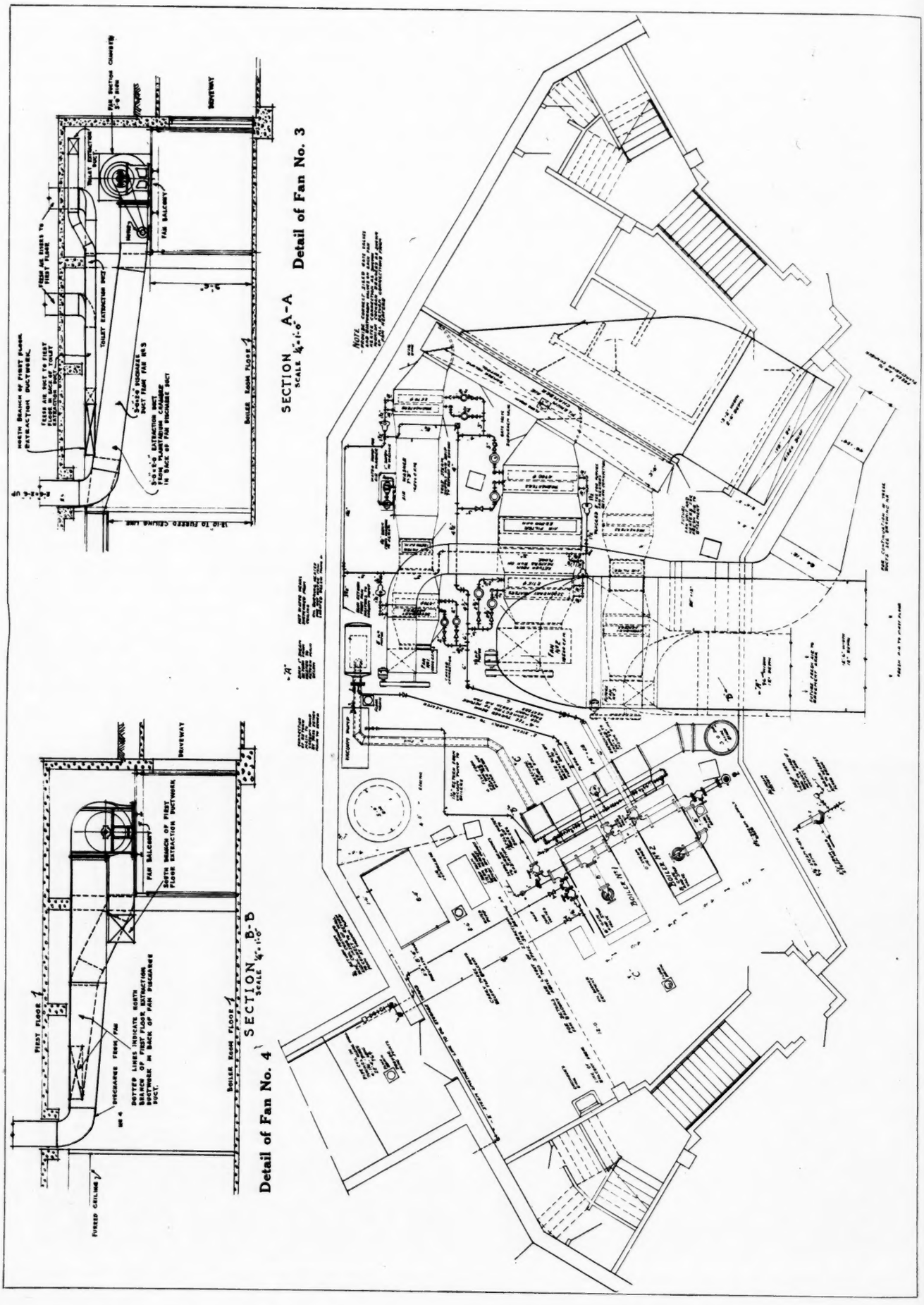
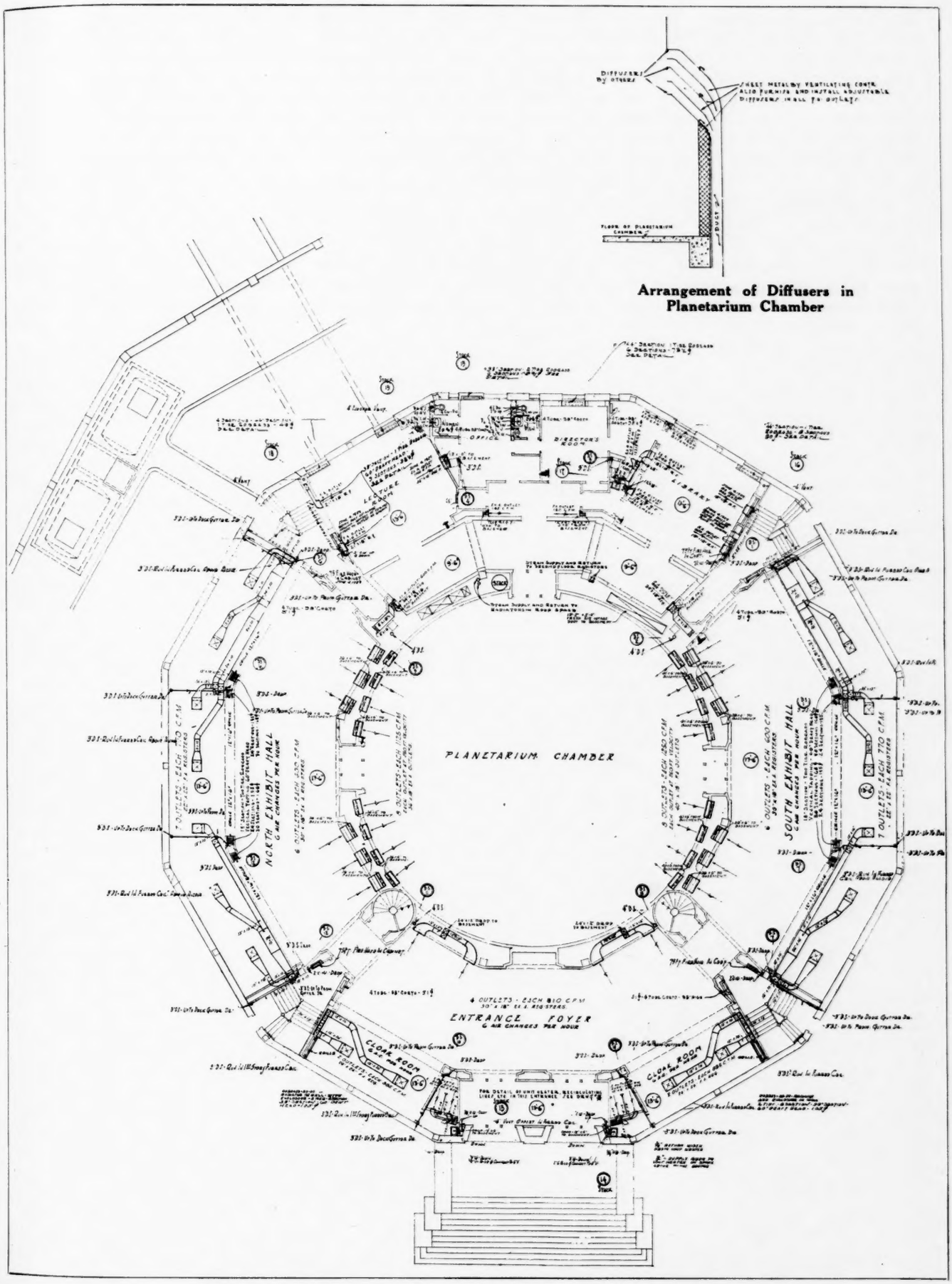


Fig. 1. Boiler and Fan Rooms, Chicago Planetarium



Arrangement of Diffusers in Planetarium Chamber

Fig. 2. Air Distribution to Planetarium Chamber and Adjoining Quarters

fixtures and duct channels. Fig. 2 shows this plan with heating, ventilation and exhaust for inner room and exhaust grilles from the exhibit chamber previously mentioned in their relationship to illuminated box displays in the outer room. Fig. 3 shows the duct courses in the same space.

The planetarium is heated with a vacuum steam system, thermostatically controlled. Oil is used for fuel for the boilers located in the basement, the oil-storage tanks being located underneath the entrance steps.

There are two fresh-air fans and two exhaust fans. The one in the planetarium chamber has a capacity of 10,000 cu. ft. per min. Exhaust fans in each case have 10% less. The exhibit hall capacity is 13,000 cu. ft. per min. A separate toilet room exhaust fan provides ventilation for the toilet rooms throughout the building.

A tunnel to the engine room from the lake provides a passage way for delivering supplies, all of which come by boat. The tunnel walls are extended to provide parking space for the cars of staff members.

One of the most interesting things about the lighting is the emergency system. In the planetarium chamber are five emergency lights run by their own battery. They are turned on by remote control at the front door or by automatic control if the normal source of service should fail. The full connected load can be carried by the emergency batteries for a 60-min. period. Thus there is no chance of not being able to give ample light for an orderly dispersal of a full quota of spectators.

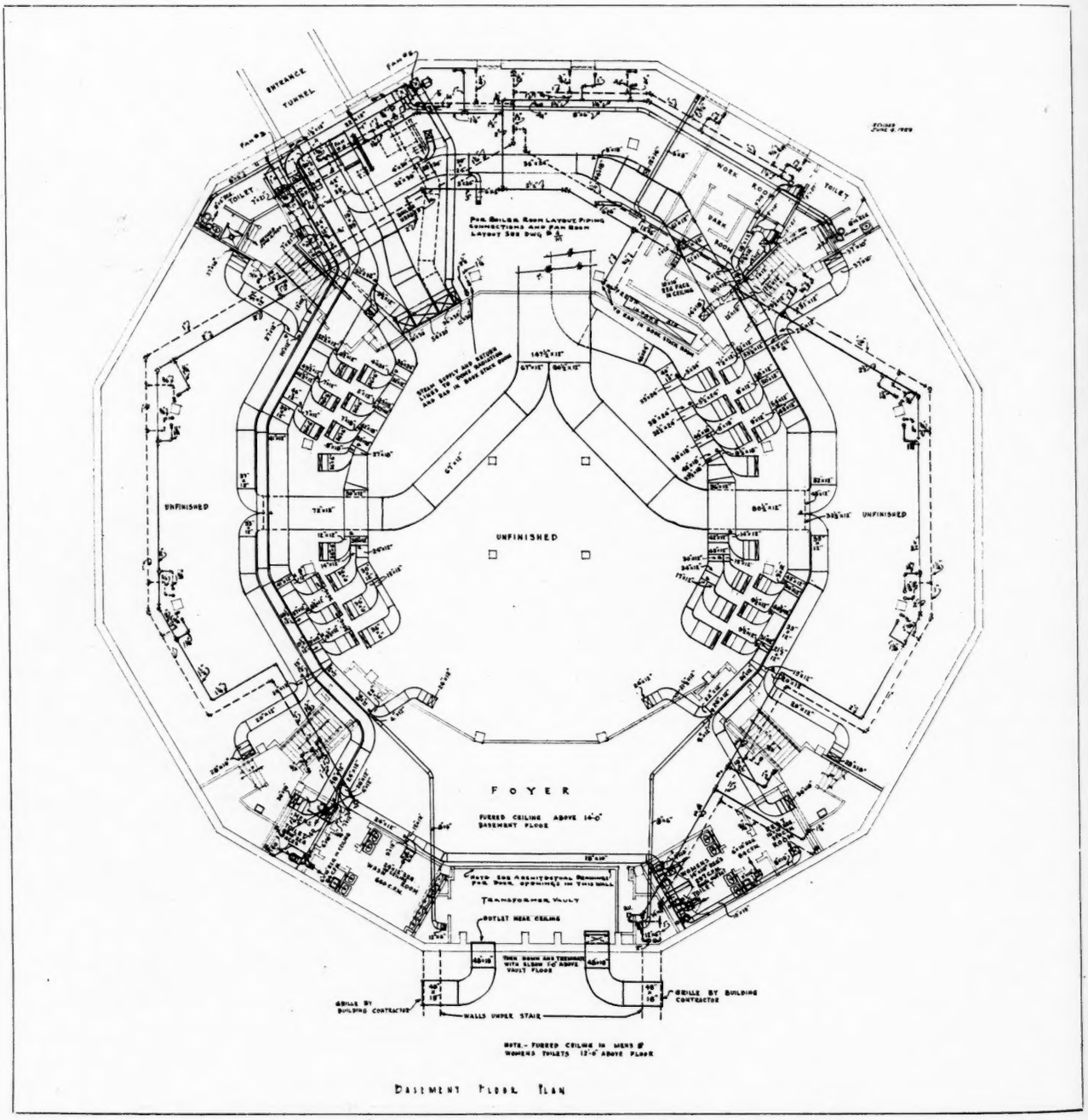


Fig. 3. Pipe and Duct Work in Basement of Chicago Planetarium

Design and Use of a Psychrometric Slide Rule

by **C. O. MACKEY**

Assistant Professor, Heat-Power Engineering, Cornell University

APPLICATION of psychrometric principles occupies a large part of the field of mechanical engineering. Heating and ventilating, controlled drying and processing of material, and cooling the water by evaporation into air, as in spray ponds and cooling towers, are specific illustrations of the industrial importance of psychrometry.

However, thermodynamic principles and relations, upon which psychrometry is based, are neither simple nor very widely comprehended. It follows that an elementary study of the above applications or the actual design of commercial apparatus in this field are attended with a large amount of hard labor. This had been fully recognized, and many attempts* have been made to lighten this work by *charting* much of the psychrometric data.

The advantages of the slide rule over the graphical chart are well known. It is more "fool proof," gives quicker interpolation and is more convenient and less fatiguing to use. If a psychrometric slide rule could be devised which would be as useful in its range as these charts, it would be as generally used as the charts. The psychrometric slide rule here presented, although limited in its range, is the equal for all practical purposes of many of the charts referred to below.

Before the method of layout and the applications of this slide rule are considered, a few of the fundamental definitions might be reviewed. The reader will be familiar with many of the terms, but they are all recorded here for ready reference.

Atmospheric air ordinarily consists of a mechanical mixture of water vapor (or steam) and dry air. The total pressure exerted by such a mixture, commonly the barometric pressure, is the sum of the partial pressures of the water vapor and dry air. Each constituent gas or vapor occupies the total mixture volume. The *relative humidity* of the atmosphere is defined as the ratio of the actual density of the water vapor in the atmosphere to the density of dry saturated vapor at atmospheric temperature. An equivalent definition of relative humidity, assuming a rectangular hyperbolic isothermal of atmospheric steam, is the ratio of the actual partial pressure of the water vapor in the atmosphere to the pressure of dry saturated steam at atmospheric temperature.

The *dew point* is that temperature at which the condensation of the water vapor in the atmosphere would begin, if cooled at constant pressure, or it is the saturation temperature corresponding to the actual partial pressure of the vapor. The *dry-bulb* temperature of the atmosphere is the temperature indicated by an ordinary thermometer with uncovered bulb. The *wet-bulb* temperature of the atmosphere is the temperature indicated by a thermometer with the bulb kept moist by a piece of wet cloth. Except for a relative humidity of 1.00, the various states of steam mentioned are shown on the accompanying pressure-volume and temperature-entropy diagrams for steam.

On these diagrams

t_1 = dry-bulb temperature
t_3 = wet-bulb temperature
t_4 = dew point.

State *1* is that of the superheated steam existing in the atmosphere, while the states *2*, *3*, and *4* are the states of dry saturated steam at the dry bulb temperature, wet bulb temperature, and dew-point, respectively.

The relative humidity, R.H., of the atmosphere may be taken as $\frac{p_1}{p_2}$ or $\frac{V_2}{V_1}$. For a relative humidity of 1.0, the dry-bulb, wet-bulb, and dew-point temperatures are all identical.

It will be assumed throughout this discussion that the wet bulb temperature is found from a sling psychrometer. This method insures that the air velocity past the wet bulb is such that the effect of the error due to the heat received by the bulb from its surroundings by radiation becomes negligible, and reliable data are secured.

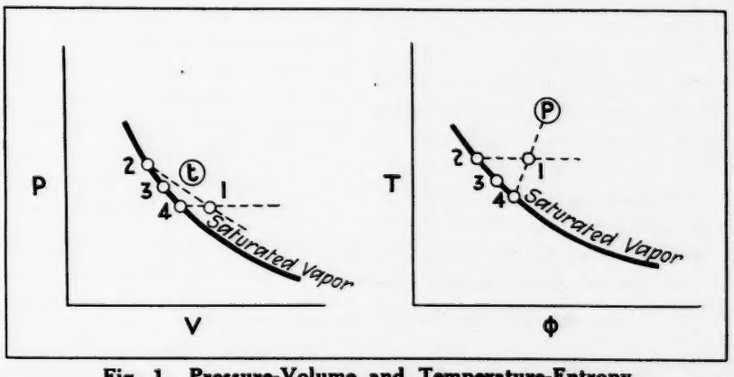


Fig. 1. Pressure-Volume and Temperature-Entropy Diagrams for Steam

*Among the well-known and widely used psychrometric charts are those of W. H. Carrier in the "Transactions of the A.S.M.E.," Vol. 33; W. M. Grosvenor in "Transactions Am. Inst. Chem. Eng.," Vol. 1, 1908; C. A. Bulkeley in "Transactions A.S.H.V.E.," Vol. 32; I. Lavine and R. L. Sutherland in "Chemical and Metallurgical Engineering," April, 1928, and J. E. Younger in "Mechanical Engineering," June, 1925.

With the dry and wet-bulb temperatures and the barometric pressure known, one of the first results an engineer would demand of a psychrometric slide rule would be the *relative humidity*. There are several reasons why the slide rule can give this result. If, for a constant barometric pressure, dry-bulb temperatures be plotted against corresponding wet-bulb temperatures for various constant relative humidities over a range of temperatures covered by the rule (the data may be secured from any standard psychrometric table), the resultant group of curves will be found to be substantially a family of straight lines having a nearly common focal point, as shown in Fig. 2. The development of an electric recorder for humidity measurement depended upon this fact.

When the mathematical functions of three variables forget their complexity long enough to line up in this way, a slide rule very quickly disposes of them. The effect of barometric pressure, in this connection, is slight, and the slide rule will be of engineering utility if laid out for a single barometric pressure. It will be recalled that most of the psychrometric charts are laid out for the standard barometric pressure, 29.92 in. of mercury and the slide rule shown is laid out for this same pressure. A numerical example taken from any psychrometric table will serve to demonstrate the small effect of barometric pressure on wet-bulb depression for a given relative humidity and dry-bulb temperature.

For a relative humidity of 0.40, at a barometric pressure of 30 in. of mercury, and a dry-bulb temperature of 80°, the wet-bulb depression is 16.3°, while at a barometric pressure of 27 in. of mercury and the same relative humidity and dry-bulb temperature, the wet-bulb depression is 16.7°. For higher relative humidities, the effect of barometric pressure is still less. Since the relative humidity commonly encountered is greater than 40%, and since the barometric pressure is usually between 28 and 30 in., a psychrometric chart or slide rule, drawn for a single barometric pressure within this range, is still of great engineering value.

The psychrometric slide rule with the two faces here pictured, has two outside stationary scales and a middle sliding scale. As indicated on face *A*, to find the relative humidity, set R.H. = 1.0 on the sliding scale over the dry bulb temperature, then simply read the *relative humidity* of the atmosphere directly over the wet-bulb temperature. This gives the relative humidity with about the same accuracy as the psychrometric chart for values of barometric pressure from 28 to 30 in. of mercury.

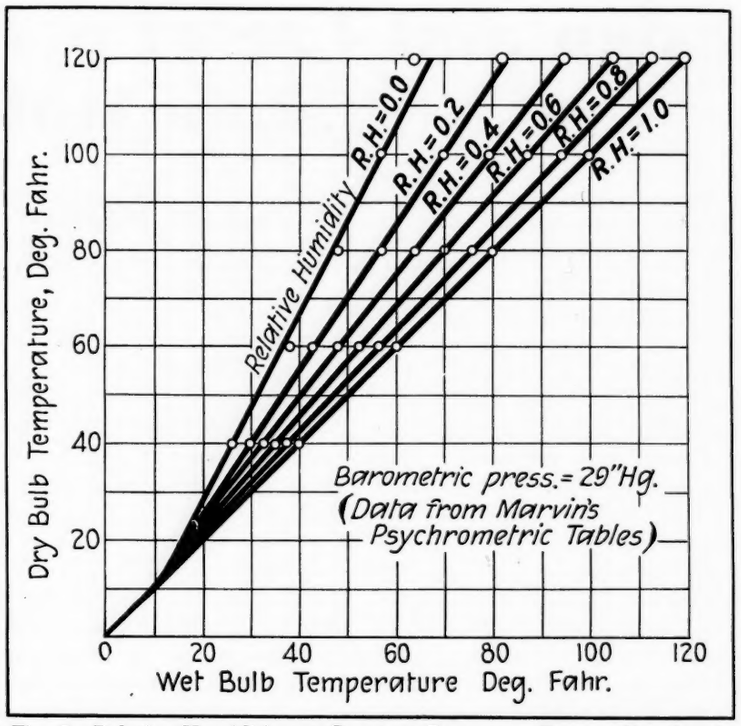


Fig. 2. Relative Humidities at Constant Barometer Form a Family of Straight Lines when Plotted with Ordinates of Wet-Bulb and Dry-Bulb Temperatures

As an illustration, with a dry-bulb temperature of 87° and a wet-bulb temperature of 74°, the slide rule indicates that the relative humidity would be 0.55, at least for barometric pressures between 28 and 30 in.

Another property of an air-water vapor mixture which is important in many engineering calculations is the so-called *"total heat"* of the mixture. Heat content, or total heat of a fluid in any state, as ordinarily used, refers to the sum of the internal energy and the pressure-volume product of the fluid in that state. As often used in psychrometric applications, however, "total heat" of a mixture has a peculiar significance.

In equation form,

$$th_1 = C_{pa}\ (t_1 - 0) + w_1 r_1 \quad (1)$$

where

th_1 = the "total heat" of the air-water vapor mixture at some *dry-bulb* temperature, t_1, in B.T.U. per pound of dry air

C_{pa} = average specific heat at constant pressure of dry air between 0 and t_1 deg. F., in B.T.U. per pound per deg. F.

w_1 = pounds of water vapor associated with each pound of dry air in the mixture

r_1 = the latent heat of vaporization of water vapor at t_1, B.T.U. per pound.

It has been stated many times, and a numerical illustration is offered in support of the fact, that the "total heat" of an air-water vapor mixture remains substantially constant as long as the wet-bulb temperature remains constant. For example, assume the wet-bulb temperature to remain constant at 49° with the barometric pressure at 30 in. Using Marvin's Psychrometric Tables, dry air with this wet-bulb temperature would have a dry-bulb temperature of 80°. Also atmospheric air with a relative humidity of 1.0 at 49° would carry 0.00736 lbs. of water vapor per lb. of dry air. The dry air would have a total heat of [(0.24 × 80) + 0] or 19.2 B.T.U. per lb. The "saturated" air would have a total heat of [(0.24 × 49) + (0.00736 × 1064)] or 19.6 B.T.U. per lb. of dry air. In this illustration the total heat of dry air

differs from the total heat of saturated air, at the same wet-bulb temperature, by 0.4 B.T.U. per lb. This difference is greater than would ordinarily be encountered in a single problem, so it is apparent that, *for many purposes*, the assumption of constant "total heat" at constant wet-bulb temperature is justified.

The total heat at any wet-bulb temperature may then be calculated, and the scale of total heat added to the slide rule, as in face *A*, so that when R.H. = 1.0, on the sliding scale, is over a certain wet-bulb temperature on the lower stationary scale, the arrow points to the "total heat" at that wet-bulb temperature. For example, in the single position of the sliding scale shown in the illustration, the slide rule indicates that the total heat of an air-water vapor mixture, with a wet-bulb temperature of 87°, is 50.4 B.T.U. per lb. of dry air.

On the reverse face *B* of the same slide rule, two more quantities may be found which are useful in many engineering calculations. With the relative humidity and the dry-bulb temperature known, the relative humidity (on the sliding scale) may be set over the dry-bulb temperature. *The pounds of water vapor present in the mixture* (or atmosphere) *per pound of dry air* may be read on the top scale directly over the arrow. With the same setting, the dew-point temperature is read on the bottom scale directly under R.H. = 1.0.

Equations Derived Through Thermodynamics

Basic equations for these scales are derived thermodynamically. In many engineering applications, where a mixture of air and water vapor is being heated or cooled, the vapor content of the air changes during the process, while the weight of dry air in the mixture remains constant, if leakage be eliminated. For this reason, the properties of the mixture, such as vapor weight and "total heat" are commonly expressed on the basis of *one pound of dry air*. To evaluate the weight of water vapor present in the mixture per pound of dry air for a barometric pressure of 29.92 in., the following equations may be written:

For R.H. = 1.0,

$$\frac{\text{pounds of saturated vapor}}{\text{pounds of dry air}} = \frac{w_d}{w_a} = \frac{\text{density of saturated steam}}{\text{density of dry air}}$$

$$= \frac{\frac{1}{V_d}}{\frac{29.92 - p_d}{0.754T}} \qquad (2)$$

where V_d = specific volume of dry saturated steam at atmospheric dry-bulb temperature, t, in cu. ft. per lb.

p_d = pressure of dry saturated steam at atmospheric temperature, in. mercury, abs.

T = absolute atmospheric temperature, deg. F. absolute.

For any relative humidity, R.H., relative humidity known, the pounds of vapor in the atmosphere per pound of dry air may be calculated from the above equation. The slide rule, then, merely solves this equation with t and R.H. known, by setting R.H. over t and reading directly the vapor weight. With the same setting, the slide rule also gives the dew point by reading the temperature under R.H. = 1.0. This is true, because by definition, the temperature at which the relative humidity is 1.0 for a given vapor content and total pressure is the dew-point temperature.

Instead of having the usual per-

$$\frac{\text{pounds of vapor}}{\text{pounds of dry air}} = \frac{w_v}{w_a} = \frac{\frac{\text{R.H.}}{V_d}}{\frac{29.92 - p_d\ (\text{R.H.})}{0.754T}}$$

$$= \frac{0.754T\ (\text{R.H.})}{V_d\ [29.92 - \text{R.H.})\ p_d]} \qquad (3)$$

For any given atmospheric temperature, V_d and p_d may be found from the steam tables, and with the versity, the above equation throws itself wide open to simple slide rule solution through what is merely a

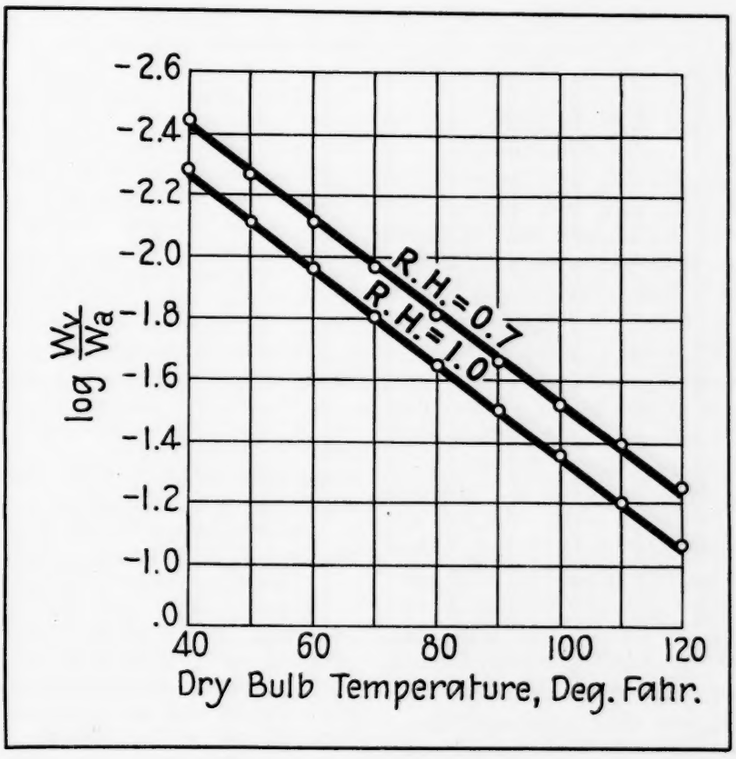


Fig. 3. The Log $\frac{W_v}{W_a}$ Plotted Against Temperature Gives Straight Relative Humidity Curves

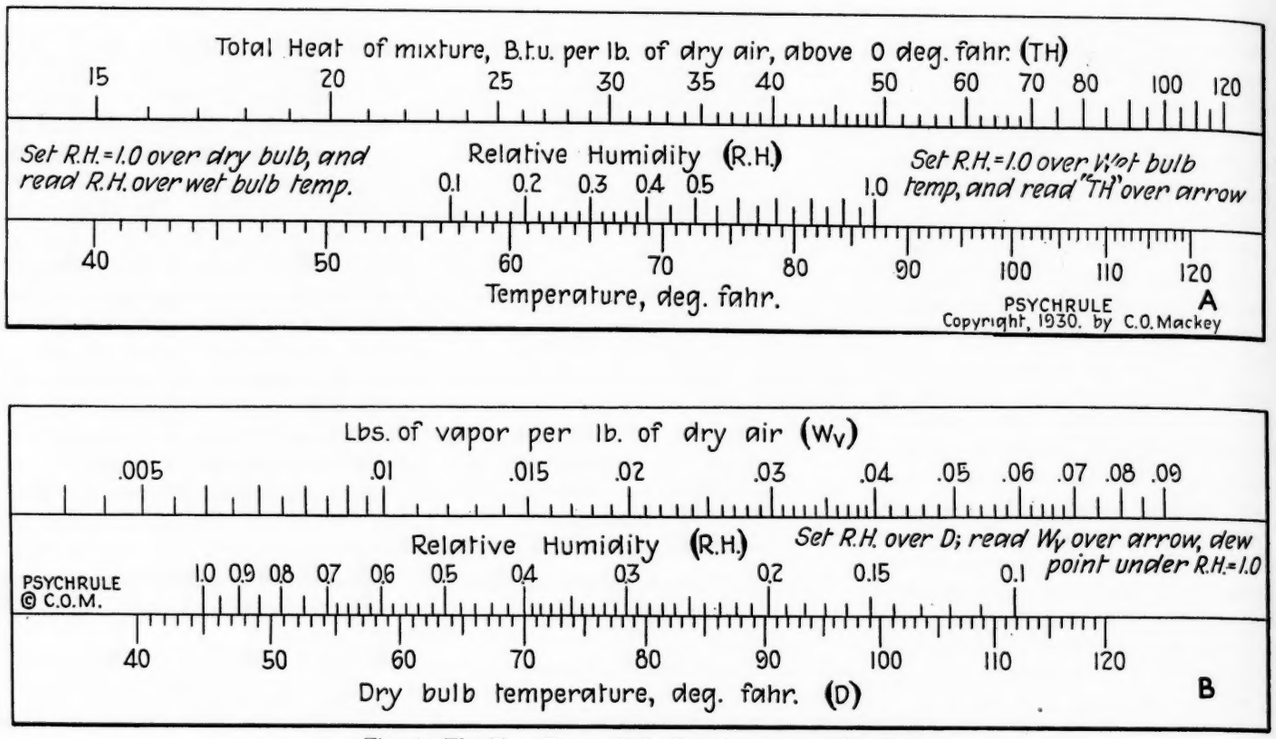

Total Heat of mixture, B.t.u. per lb. of dry air, above 0 deg. fahr. (TH)
15 20 25 30 35 40 50 60 70 80 100 120
Set R.H.=1.0 over dry bulb, and read R.H. over wet bulb temp.
Relative Humidity (R.H.)
0.1 0.2 0.3 0.4 0.5 1.0
Set R.H.=1.0 over Wet bulb temp, and read "TH" over arrow
40 50 60 70 80 90 100 110 120
Temperature, deg. fahr.
PSYCHRULE
Copyright, 1930, by C.O.Mackey
A
Lbs. of vapor per lb. of dry air (Wv)
.005 .01 .015 .02 .03 .04 .05 .06 .07 .08 .09
Relative Humidity (R.H.)
Set R.H. over D; read Wv over arrow, dew point under R.H.=1.0
PSYCHRULE
© C.O.M.
1.0 0.9 0.8 0.7 0.6 0.5 0.4 0.3 0.2 0.15 0.1
40 50 60 70 80 90 100 110 120
Dry bulb temperature, deg. fahr. (D)
B

Fig. 4. The Two Faces of the Psychrometric Slide Rule
The outside scales are stationary and the middle scales are sliding

lucky "break." If, for a constant relative humidity, values of log $\frac{w_v}{w_a}$ be plotted against t, they fall on a line which, for all engineering purposes, is straight. The plot of log $\frac{w_v}{w_a}$ against t, for relative humidities of 1.0 and 0.70, is given here in Fig. 3 to verify this statement.

As an illustration of the use of the rule to find the pounds of vapor per pound of dry air and the dew point, suppose these quantities are required when the atmospheric dry-bulb temperature is 70° and the relative humidity is 40%. Setting R.H. = 0.40 over D = 70° as in the one position of the sliding scale illustrated on face *B*, we find the pounds of vapor per lb. of dry air to be 0.0063 over the arrow and the dew point to be 45° under R.H. = 1.0.

The psychrometric slide rule illustrated quickly gives the total heat, the weight of vapor associated with 1 lb. of dry air, the dew point, and the relative humidity from wet and dry-bulb thermometer readings, accurately enough for many engineering purposes, for a range of temperatures from 40° to 120°.

Some physical problems which may be solved using the psychrometric slide rule follow:

Problems in Heating and Ventilating

Saturated air at a temperature of 40° is heated without the addition of any moisture, until a temperature of 80° is reached. Find the final relative humidity, wet-bulb temperature, and the heat added per pound of dry air heated. On face *B* of the rule, set R.H. = 1.0 over dry-bulb temperature of 40°, and over a dry-bulb temperature of 80°, read the final relative humidity of 0.23. Also from the rule, it is apparent that the weight of vapor present is 0.0052 lbs. per lb. of dry air.

Now, on the other side of the rule, if R.H. = 1.0 be set over the dry bulb temperature, 80°, the wet-bulb temperature will be found under R.H. = 0.23, and is 57.5°. The total heat of the initial air vapor mixture at a wet-bulb temperature of 40° is seen to be 15.2 B.T.U. per lb. of dry air. At the final wet-bulb temperature of 57.5°, the total heat is 24.6 B.T.U. per lb. of dry air, and therefore during the heating approximately 9.4 B.T.U. must be supplied the mixture per lb. of dry air heated.

In this particular problem, however, if a very accurate result is required the difference between the heat contents must be found rather than the difference in the total heats of the mixture. Since the total heat does not include the heat content of the liquid, a plus correction equal to the product of the weight of the vapor by the difference in the heat contents of the liquid at 80° and 40° must be used.

For example, a more exact value of the heat supplied would be (9.4 + 0.0052 × 40) or 9.61 B.T.U. per lb. of dry air. This correction, however, is commonly ignored, when psychrometric charts are used.

As another illustration, suppose that in the preceding problem a final relative humidity of the air of at least 0.35 is desired for human comfort; required, the amount of water which must be evaporated per pound of dry air heated to attain this relative humidity.

On face *B* of the slide rule, set R.H. = 0.35 over a dry-bulb temperature of 80° and read 0.0078 lbs. of vapor per lb. of dry air. It would then be necessary to add (0.0078 — 0.0052) or 0.0026 lbs. of water per lb. of dry air.

Problems in Air Conditioning

To illustrate the use of the rule in air-conditioning problems, assume that the dry-bulb temperature of the outside air is 90° and the relative humidity is 0.40 with normal barometric pressure. Suppose that a relative humidity of 0.60 is required in a textile mill, and that the air is to be humidified to meet this requirement; required, the final dry-bulb temperature of the air.

From face *A* of the slide rule the wet bulb temperature of the outside air is found to be 71°. The air can be saturated in the humidifier at this tempera-

ture, and the dew point of the air in the enclosure will be 71°. On face *B* of the rule, set R.H. = 1.0 over a temperature of 71° and under the required R.H. of 0.6 read the necessary dry-bulb temperature, 86°. The amount of water which must be supplied by the humidifier per pound of dry air circulated may also be found on the slide rule for this case. For a dry-bulb temperature of 90° and a relative humidity of 0.40, the pounds of vapor carried per pound of dry outside air is 0.0124. For a dry-bulb temperature of 86° and a relative humidity of 0.6, the pounds of vapor carried per pound of dry air is 0.0163. Hence, 0.0039 lbs. of water must be supplied per pound of dry air circulated.

Problems in Dehumidifying

As an example of dehumidifying, assume that the outside dry and wet-bulb temperatures are 95° and 90° respectively, with a normal barometer. It may be desired to maintain a dry-bulb temperature of 65° and a relative humidity of 0.5 in a candy plant; required, the dew-point temperature that must be maintained at the air conditioner outlet.

On face *B* of the rule, setting R.H. = 0.5 over a dry-bulb temperature of 65° gives the required dew-point temperature of 46° and also the vapor content of the air leaving the conditioning unit as 0.0066 lbs. per lb. of dry air. In order to find the vapor content of the outside air, the relative humidity is found on face *A* to be 0.82, and then on face *B* for R.H. = 0.82 and a dry-bulb temperature of 95°, the vapor content is read as 0.03 lbs. per lb. of dry air. The weight of vapor condensed per pound of dry air conditioned is then 0.0234 lbs.

As another illustration of the use of the rule, and also of the term total heat, consider the psychrometric problem in connection with a cooling tower. The following notation will be used:

w = weight of circulating water passing through the tower, in lbs. per min.
w_a = weight of *dry* air passing through tower, in lbs. per min.
w^1 = weight of water evaporated per lb. of dry air circulated, in lbs.
t_1 = temp. of water entering tower, deg. F.
h_1 = heat content of water entering tower, in B.T.U. per lb.
t_2 = temp. of water leaving tower, deg. F.
h_2 = heat content of water leaving tower, in B.T.U. per lb.
t_a = dry-bulb. temp. of air entering tower, deg. F.
t_b = dry-bulb temp. of air leaving tower, deg. F.
h_a = heat content of air-vapor mixture entering tower, in B.T.U. per lb. of dry air.
th_a = Total heat of air-vapor mixture entering tower, in B.T.U. per lb. of dry air.
h_b = heat content of air-vapor mixture leaving tower, in B.T.U. per lb. of dry air.
th_b = total heat of air-vapor mixture leaving tower, in B.T.U. per lb. of dry air.

By the conservation of energy principle, neglecting external heat losses,

$$wh_1 - (w - w^1 w_a)\, h_2 = w_a\,(h_b - h_a)$$

$$w_a = \frac{w\,(h_1 - h_2)}{h_b - h_a - w^1 h_a}$$

For common temperatures of the water,

$$h_1 - h_2 = t_1 - t_2,$$

so

$$w_a = \frac{w\,(t_1 - t_2)}{h_b - h_a - w^1 h_2} \qquad (4)$$

Since

$$h_b = th_b + w_{vb}\, h_{1b}$$

Where w_{vb} = weight of vapor carried by each lb. of exit dry air in lbs.
h_{1b} = heat content of water at t_b, B.T.U. per lb.

And

$$h_a = th_a + w_{va}\, h_{1a}$$

where

w_{va} = weight of vapor carried by each lb. of entering dry air, in lbs.
h_{1a} = heat content of water at t_a, B.T.U. per lb.

Also

$$w_a = \frac{w\,(t_1 - t_2)}{th_b - th_a + w_{vb}\, h_{1b} - w_{va}\, h_{1a} - w^1 h_2}$$

But

$$w^1 = w_{vb} - w_{va}$$

Commonly,

h_2 is between h_{1b} and h_{1a} since t_2 is between t_a and t_b

Therefore, since

$$w_{vb}\, h_{1b} - w_{va}\, h_{1a} - w^1 h_2 \text{ nearly} = 0,$$

$$w_a = \frac{w\,(t_1 - t_2)}{th_b - th_a} \text{ approximately} \qquad (5)$$

If total heat is to be used in cooling tower problems, it should be used in Equation 5, rather than using this term exactly as if it were heat content in Equation 4.

Problems in Cooling Tower Calculations

To illustrate with a numerical solution:

A tower is to cool 683 gallons of water per min. from 108° to 88°, with the atmosphere at 72° and a wet-bulb temperature of 63°. Tests show that, with a forced draft tower, the air will leave at 93° with a relative humidity of 100%. It is desired to find the number of pounds of dry air which must be circulated per minute.

From face *A* of the slide rule, the initial relative humidity of the air is found to be 0.61 and hence the pounds of vapor carried by each pound of entering dry air is found, on face *B* of the rule, to be 0.0103. Upon exit, the rule also shows each pound of dry air is accompanied by 0.0343 lbs. of vapor, by setting R.H. = 1.0 over D = 93. Hence each pound of dry air picked up 0.024 lbs. of water vapor in its passage through the tower. From the slide rule, the total heat of the air entering the tower is 28.2 B.T.U. per lb. of dry air. Substituting in Equation 5, the weight of dry air which must be circulated per minute is

$$\frac{638 \times 8.33 \times 20}{58.2 - 28.2} \text{ or } 3540 \text{ lbs.}$$

In summary, the numerical illustrations given may show that the psychrometric slide rule in pocket size illustrated here is much more convenient to use than the chart, and that problems may be solved more quickly with less chance of error than with the chart, although the field of application of the two is the same.

Economics of Thermal Building Insulation

by **PAUL D. CLOSE**

THE selection of most securities and many commodities is governed largely by the return for the money expended. In fact, in most cases the selling price is fixed within comparatively narrow limits by the *dividend* rate or earning power of the instrument involved, although subject in many cases to deviation from the normal value because of the possibility of depreciation or appreciation. A sound mortgage security, for example, if paying $5 or $6 per annum, will automatically have a market value of approximately $100, because an average return of 5% or 6% generally is considered satisfactory for this type of security, notwithstanding the fact that this ratio between dividend and cost of security is more or less arbitrarily fixed.

From the economic point of view, selection of a commercial heat insulation is not unlike the selection of any other commodity or security having a tangible earning power, excepting perhaps for the so-called *dividend* rate. With present available data, it is a comparatively simple problem to estimate with reasonable accuracy the fuel and radiation savings that will result from the installation of any type and thickness of insulation for any given set of conditions. If these savings are properly evaluated and applied against the cost of the insulation, the return on the insulation investment can readily be determined. In one instance, the return may not be sufficient to warrant the use of the thickness contemplated, whereas in another instance the return may be entirely satisfactory, but the thickness may not be sufficient to reduce the heat losses of the wall or roof to the necessary extent.

Return on insulation investment, resulting from the fuel and radiation savings obtained, follows the law of diminishing return. In other words, the greater the thickness, the less the return, and while a very small thickness of insulation might, under certain conditions, result in a very high dividend rate, this thickness would not necessarily be the economic thickness, because of the excessive heat loss due to insufficient insulation. It is therefore apparent that the thickness of wall or roof insulation is governed, *first*, by the necessity of minimizing the heat losses of a building, and *second*, by the return on the insulation investment. If the insulation cost (based on efficiency) is within reasonable limits, the first factor is dependent, in a measure, on the second. Hence, by fixing the return on the insulation investment, the thickness may also be fixed.

The question then arises as to the minimum acceptable return on the insulation investment. If the usual reasoning were followed, the tendency would be to secure the maximum possible return for the money expended for insulation, but as previously stated, even though a lesser thickness of insulation means a greater return, it also means an extravagant loss of heat, which will offset the advantage of the high rate of return from the insulation investment.

It is sometimes said that the heat transmission coefficient of a wall should be reduced, by installing insulation, to 0.10 if manufactured gas is used for heating the building. However, the required coefficient of the wall depends on the coefficient of the uninsulated wall, the cost of the insulation, the cost of the fuel and other factors. For example, if under certain conditions the insulation cost were excessive, only a very small thickness would pay a satisfactory return, and under the circumstances, the wall coefficient might be considerably higher than 0.10.

On the other hand, the conditions might be such as to permit the installation of a thickness of insulation sufficient to reduce the wall coefficient to much less than 0.10. It is therefore illogical to state that the wall or roof coefficient should have any fixed value for a given type of fuel.

All of the various factors entering into the problem must be taken into consideration to determine what thickness of insulation should be used and consequently what the wall or roof coefficient should be. These factors include cost of insulation and fuel, type of construction and manner of installation of insulation, location of building, heating efficiency and the return expected on the insulation investment. This return, which should be used as the basis for selecting the proper thickness of insulation, must necessarily be arbitrary, just as the return of 5% or 6% on mortgage securities is largely arbitrary. In other words, *the correct thickness of insulation is that thickness, the tangible savings of which, when properly evaluated, will result in a reasonable return on the insulation investment.* Any lesser return would approach the average dividend rate of common and preferred stocks; any greater return would mean an insufficient thickness of insulation. The return must necessarily be greater than is derived from the average security to allow for the interest, depreciation and yearly repair charge on the investment in the insulation and its installation.

A formula (together with its derivation) for estimating the proper thickness of insulation when coal is used for fuel is presented. While the selection of the proper thickness of insulation has been largely arbitrary up to the present time, without any knowledge, in most cases, as to whether the insulation investment was within economic limits, this formula makes it possible accurately to select the correct amount of insulation, with only one discretionary variable—the return on the investment.

Derivation of Formula for Coal

The fuel saving (F_c) in tons of

coal per heating season, for *1 sq. ft. of wall or roof area*, resulting from the installation of any thickness of insulation, may be obtained by substituting the proper values in the following formula:

$$F_c = \frac{(U - U_1) \times N \times (t - t_a)}{C_c \times E_c \times 2000} \quad (1)$$

where—

U = Coefficient of transmission of uninsulated wall or roof in B.T.U. per hour per square foot per degree F.

U_1 = Coefficient of transmission of insulated wall or roof in B.T.U. per hour per square foot per degree F.

N = Number of hours during the heating season

t = Average inside temperature near wall or roof in degrees F.

t_a = Average outside temperature during heating season in degrees F.

C_c = Calorific value of coal in B.T.U. per pound

E_c = Overall heating efficiency for coal in per cent (expressed as a decimal)

Return on the insulation investment is equal to the monetary value of the fuel saving divided by the cost of the insulation and multiplied by 100 to change to per cent.

Let

r = return on the investment in per cent

c = cost of coal in dollars per ton

Y_c = thickness of insulation for coal in inches

z = installed cost of insulation in cents per square foot *per inch thickness.*

The monetary value of the fuel saving is equal to $F_c \times c$ dollars, where F_c is given in terms of 1 sq. ft. of wall or roof area, and the installed cost of the insulation per square foot of wall or roof area is equal to $\frac{Y_c \times z}{100}$ dollars. Therefore—

$$r = \frac{100 \times F_c \times c}{\frac{Y_c \times z}{100}} = \frac{10{,}000 \times F_c \times c}{Y_c \times z} \quad (2)$$

In equation (1), let $\frac{N \times (t - t_a)}{C_c \times E_c \times 2000} = A$; then,

$$F_c = (U - U_1) \times A \quad (3)$$

From equations (2) and (3)—

$$F_c = \frac{r \times Y_c \times z}{10{,}000 \times c} = (U - U_1) \times A \quad (4)$$

The coefficient of transmission of the insulated wall or roof (U_1) is derived from the basic equation

$$U_1 = \frac{1}{\frac{1}{U} + \frac{Y_c}{k}} \quad (5)$$

Substituting the value of U_1 from equation (5) in equation (4)

$$\frac{r \times Y_c \times z}{10{,}000 \times c} = \left[U - \frac{1}{\frac{1}{U} + \frac{Y_c}{k}}\right] \times A \quad (6)$$

Solving for Y_c—

$$Y_c = \frac{10{,}000 \times c \times A \times U}{r \times z} - \frac{k}{U} \quad (7)$$

Substituting the value of A in equation (7)

$$Y_c = \frac{5 \times c \times N \times (t - t_a) \times U}{r \times z \times C_c \times E_c} - \frac{k}{U} \quad (8)$$

In order to simplify this formula, assume the average calorific value of coal (C_c) to be 13,000 B.T.U. per lb.; the heating efficiency (E_c), 0.60; and the duration of the heating season (N), 210 days or 5040 hrs. If the average outside temperature (t_a) is used for this period of time, the length of which is approximately equivalent to the number of hours from October 1 to May 1, the error in so doing will be slight, even though the actual heating season may be other than October 1 to May 1.

Substituting these values in equation (8), it becomes—

$$Y_c = \frac{3.23 \times c \times (t - t_a) \times U}{r \times z} - \frac{k}{U} \quad \text{(Formula A)}$$

The installed insulation cost per inch thickness (z) is assumed constant in this formula, although in many cases the cost per inch may decrease with an increase in the thickness. Consequently, it may be necessary in some cases to adopt a *trial and error* process in order to use the approximate insulation cost for the thickness required.

It should be emphasized that this formula is not intended to be used as a basis for rating insulations, but rather to select the proper thickness of a given type of insulation for the conditions involved. No consideration is given to the influence of the radiation saving on the insulation thickness, which will be discussed later, as will also the effect of installing insulations used in place of other materials ordinarily used in building construction and those which increase or decrease the number of air spaces in the wall or roof.

The following typical problem will illustrate the use of Formula A: Determine the thickness of insulation required for a factory roof constructed of 2-in. planks and covered with built-up roofing, based on coal at $9 per ton, and insulation having a conductivity of 0.30 and costing 11 cents per sq. ft. per in. thickness installed. The building is located in Detroit, Mich., the average inside air temperature (near the roof) is estimated to be 77° and the desired return on the investment is 20%. The various factors in this case have the following values:

$c = 9.00$
$t = 77$
$t_a = 35.4$ (See Table 1)
$U = 0.345$ (See A.S.H.V.E. *Guide*, 1930)
$r = 20$
$z = 11$
$k = 0.30$

Substituting these values in Formula A—

$$Y_c = \frac{3.23 \times 9 \times (77 - 35.4) \times 0.345}{20 \times 11} - \frac{0.30}{0.345}$$

$= 1.03$ in. (or 1 in.)

Variation in Thickness With Cost of Coal and Roof Construction

Many interesting deductions can be made from this formula, since the thickness of insulation varies with changes in each of the variables involved when the others remain constant. For example, consider the effect of the change in the cost of fuel in the problem just cited when the other factors remain the same.

The more costly the fuel, the greater the thickness of insulation required. On the other hand, if the fuel is sufficiently cheap there is no advantage in using insulation, at least from the *fuel saving* standpoint. These facts are borne out by an inspection of Formula A, from which it will be noted that the thickness of insulation varies directly with the cost of coal. In the foregoing problem, the relation between thickness and cost is:

$$Y_c = 0.211 \times c - 0.87 \qquad (9)$$

If the gross cost of coal is $15 per ton, the thickness of insulation becomes 2.3 in., whereas at $20 per ton, the required thickness is 3.35 in. On the other hand, if the cost of coal including the handling thereof and disposal of ashes amounts to only $4.12 per ton, the insulation thickness becomes zero, assuming that a return of 20% is desired and that the other factors remain as before.

Changes in the roof construction vary the coefficient of transmission (U) and increase or decrease the required thickness of insulation. In the problem under consideration, the relation between the roof coefficient and the insulation thickness is:

$$Y_c = 5.48 \times U - \frac{0.30}{U} \qquad (10)$$

If the roof coefficient is 0.234, no insulation is required, at least if a return of 20% on the insulation investment is desired. But if the roof were constructed of 4-in. concrete ($U = 0.568$) instead of 2-in. planks as originally figured, a thickness of more than 2½ in. would be required, whereas a flat metal roof deck including roofing ($U = 0.781$) would necessitate the use of a thickness of 3.9 in. of insulation.

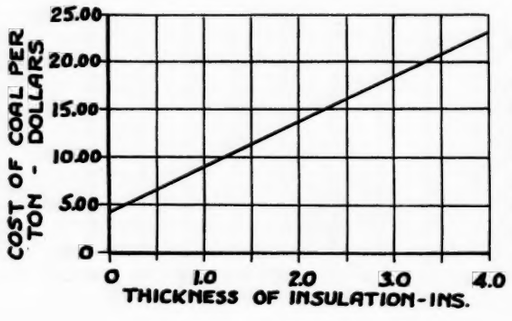


Fig. 1. Variation in Thickness of Insulation with Cost of Coal

Based on the following conditions:
Roof construction: 2 in. planks, built-up roofing.
Air Temperature at roof: 77° F.
Average outside temperature: 35.4° F.
Return on investment: 20%.
Cost of insulation, installed: 11c per sq. ft. per in. thickness.
Conductivity of insulation: 0.30 B.T.U. per hr. per sq. ft. per deg. F. per in. thickness.

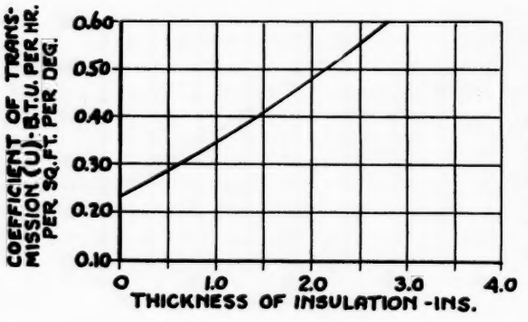


Fig. 2. Variation in Thickness of Insulation with Coefficient of Transmission (U) of Roof (or Wall)

Based on the following conditions:
Cost of Coal: $9 per ton.
Air Temperature at roof: 77° F.
Average outside temperature: 35.4° F.
Return on investment: 20%.
Cost of insulation, installed: 11c per sq. ft. per in. thickness.
Conductivity of insulation: 0.30 B.T.U. per hr. per sq. ft. per deg. F. per in. thickness.

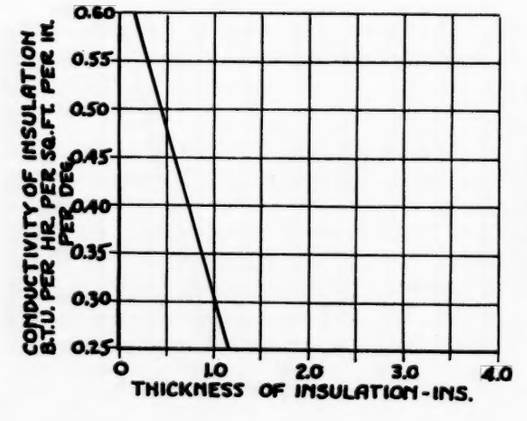


Fig. 3. Variation in Thickness of Insulation with Conductivity of Insulation

Based on the following conditions:
Roof construction: 2 in. planks, built-up roofing.
Cost of Coal: $9 per ton.
Air Temperature at roof: 77° F.
Average outside temperature: 35.4° F.
Return on investment: 20%.
Cost of insulation, installed: 11c per sq. ft. per in. thickness.

Variation in Thickness With Conductivity of Insulation

The relation between the conductivity of insulation and the thickness required for this problem is:

$$Y_c = 1.90 - \frac{k}{0.345} \qquad (11)$$

Therefore, an increase in the conductivity (for the same cost per inch thickness) will result in a decrease in the thickness, as shown by Fig. 3. This is probably contrary to the usual expectation, but the explanation lies in the fact that an increase in the conductivity results in a decrease in the fuel saving, which means that the insulation thickness must be reduced to obtain the same return on the investment of 20%. If the overall resistance is to remain the same, then an increase in the conductivity of the insulation would also necessitate an increase in the thickness, but as previously stated, if the return on the investment is to remain constant, the thickness decreases with an increase in the conductivity, and vice versa.

It will be noted from Fig. 3 that the insulation thickness becomes *zero* when the conductivity is 0.655 for the specific conditions involved. If the conductivity is 0.40, the thickness is 0.74 in. whereas if the conductivity is only 0.20, the thickness is 1.32 in. It is apparent that the effect of the conductivity is less marked than that of other factors. Another significant fact is that the conductivity of a material must be sufficiently low in order to justify its use for insulating purposes, unless its unit cost is correspondingly low.

(To be continued)

Application of Combustion Engineering to the Heating Plant

by **T. A. MARSH**

ADOPTION of stokers for heating plants of 500 sq. ft. of heating surface and more, is an accepted fact, proven by the installation of approximately 20,000 units in 1929. There are, too, without question, many highly developed stokers on the market today giving the purchaser all of the advantages of automatic heat with coal, smokelessness, less labor and real fuel economy.

With all of these advantages and well-developed stokers there is still too large a percentage of stoker installations wherein the user is not obtaining the best and in some cases even the proper results. The primary reason for this is that the problem has not been given the engineering experience and consideration it warrants and merits.

The same situation existed several years ago in the larger stoker field in which the author has been engaged for many years. When that industry lacked the engineering talent it now possesses it also fell far short of obtaining maximum results from installations.

Installation of stokers, regardless of size, is a real engineering problem. The same identical elements exist in small installations as in large, complicated also by the greater possibility of faulty draft conditions and an absence of engineering talent on the part of the purchaser. These facts make it more essential that the stoker organization serving the heating plants be more carefully supervised than is necessary in the larger stoker field.

In the past too much has been taken for granted in the thought that the stoker alone will do everything. There are several basic items to consider in making a stoker installation, even assuming that the stoker itself is perfect. Improper judgment on any one of these will cause the installation to fall short of the best and may actually cause serious difficulties. Among these items are: (1) nature of the load the boiler must carry, (2) rating at which the boiler must operate, (3) peak load or maximum hours fuel consumption, (4) size of the stoker, (5) design of the furnace and, (6) provision for draft.

T. A. Marsh is widely known as a combustion expert in the power field, and for seven years served as western engineer and district representative of the Combustion Engineering Corporation. He also is the author of "Combustion in the Power Plant." Recently Mr. Marsh was appointed president of a mid-western company manufacturing bituminous burning commercial stokers.

In considering these problems, four of these items deserve special mention. One is the maximum hours fuel consumption. This is the most essential piece of information to be obtained in engineering a stoker installation. It is sometimes difficult to obtain as the heating load frequently is complicated by hot water load, swimming pools, and such loads. However, data are available so that experienced engineers can determine with considerable accuracy what the maximum hours fuel consumption will be.

Next in consideration is the size of the stoker. Having determined the maximum hours fuel consumption the application of the proper-sized stoker would appear to be simple. It is, but is all too frequently governed by commercialism tending toward the minimum size of stoker that will burn this amount of coal. This is not the best engineering practice either for the stoker company or for the purchaser. The minimum size of stoker may serve the purpose and the installation may be satisfactory. There is, however, always the hazard of trouble which frequently develops. Minimum-sized stokers have to operate more of the time than liberally-sized stokers. The consumption of electric current is therefore higher. Frequently, too, a selection of the better and more expensive coals is desirable if not altogether necessary.

Looked at from the other angle, stokers of liberal size cost very little more than those of minimum size. The insurance against difficulties warrants this slight extra amount. Certainly the work of the stoker will be done more easily. Too, the stoker will burn a wider range of coals and will be more responsive to the early morning warming up period in sub-zero weather when the usual maximum demand is on the stoker.

It is not good combustion engineering to recommend stokers "just large enough," but to know the proper size and allow a proper margin, not only to take care of unexpected conditions, but to provide a stoker which will not be forced to its limit on severest days. In general, the thoroughly experienced engineer will be more conservative than the inexperienced engineer.

Proper furnace design must be considered from the standpoint of relationship of fuel bed to heating surface in order that there shall be no obstruction to the fuel bed. Further, there shall be no interference with gas flow, and combustion space must be considered.

Proper draft provision is essential for a good installation. The analysis of draft conditions is a study in itself.

It is evident from this brief consideration of a few selected elements affecting stoker installations that it is a problem for experienced combustion engineers. There are other important points of stoker engineering not quite so prominent as these. There is too the engineering of the design of the stoker itself. This alone requires wide experience and specialized design knowledge. This was definitely proved in the larger stoker industry.

This does not mean that expert engineers are required to sell, install and operate stokers in heating plants. On the contrary, proper and thorough engineering at the base or home office of the stoker company and conservatism in engineering insures the salesman, distributor, contractor, installation man and the ultimate user a successful installation. Without such engineering the structure has no adequate foundation. Standards are not available, unnecessary risks are undertaken and a good installation, if obtained, is through good fortune.

Electric Steam Heating in Large Buildings

COST of operation, including fixed charges, practically equal to that possible with a coke-burning plant, was reported for a large electric steam heating system in the Carliol House, Newcastle-on-Tyne, England, at a recent meeting of the Institution of Electrical Engineers in Great Britain.

Separate boilers and storage cylinders are used with intermediate calorifiers, the latter being a cast-iron drum, tubed from end to end after the manner of a surface condenser, with a steam space outside the tubes. The steam from the boilers is passed into the outer space between the tubes, while through the latter the water from the storage cylinder is pumped and so warmed by contact with the steam-heated tubes. During this process the steam becomes condensed and passes from the calorifier through a trap system, thence to a feed or make-up tank to be repumped to the boiler.

The boilers deliver steam at 55 lbs. per sq. in., the steam production being controlled by an electric regulating-valve system which balances the water input against the electrical input, in addition to which there is a pressure-retaining valve which maintains a fixed steam pressure on the boilers and opens only to pass steam to the calorifiers when the pressure exceeds this value.

The two storage cylinders each measures 34 ft. in length and 9 ft. 6 in. in diameter and inclose a total water volume of approximately 4800 cu. ft., or 30,000 gal. under a pressure of 48 lbs. per sq. in. Hence at storage temperature (i.e., 230° F.) there are contained in this volume of water approximately 60,000,000 B.T.U., of which about 50,000,000 is available for ordinary use, the balance representing the heat first expended in raising the temperature of the main water from 50° to 100°.

Temperature Regulation. The temperature of the water supplying the central heating system is regulated automatically by means of a relay valve system hydraulically operated and controlled by means of a thermostat in the main hot-water flow pipe, so adjusted as to maintain a normal circulating temperature of 110° F. to 120° F., which corresponds to a temperature of 63° F. at all points throughout the building, under all weather conditions. The temperature of the circulating water can be raised to 130° F. for quick heating.

Consumption. The building as so far erected is incomplete, but that portion which is in use and has been occupied for two heating seasons has a content of 1,750,000 cu. ft.

During the last complete heating period, which was of great severity, an average daily input of 5300 kw.-hr., i.e., 18,000,000 B. T. U. was required. The average outside temperature during this period was 44.3° F. and the air in the building was maintained at a temperature of 63° F.

The electrical consumption per office at 2000 cu. ft. capacity was 46 kw.-hr. per week, which at 0.6 cent per kw.-hr. represents a weekly cost of about 27.6 cents.

The consumption of current in all cases was from 7 P.M. to 7 A.M.

On the question of maintenance charges there is little to be said. Beyond opening out the boilers for annual inspection, which occupies two days, the only expenditure that has been incurred has been the provision of one set of electrodes at a cost of $25.

Hot-Water Service System. In addition to the central heating system there is a separate storage cylinder of 1000 cu. ft. capacity, working under a pressure of 48 lbs. per sq. in., to supply the domestic hot-water requirements of the building.

This cylinder has a total heat-storage capacity of 15,000,000 B.T.U., of which approximately 11,000,000 are available for use. This cylinder derives its heat from the boiler main steam-range, but it differs from the other storage cylinders in that it is fitted with a calorifier forming an integral part of it.

The following table is a comparison of the costs of the system as compared with a coke-fired system. These figures do not include the saving on flues and chimneys. Also, certain labor charges are high on the electric system, which will be eliminated when the complete automatic apparatus has been installed.

COMPARISON OF STEAM COSTS, COKE AND ELECTRIC SYSTEMS

	Coke	Electric
Capital Charges		
Cost of whole system, including domestic hot-water apparatus	$18,000	$28,000
Estimated Annual Charges		
Energy—1,100,000 kw.-hr. at 0.6 cent	.....	6,875
Fuel—500 tons coke at $6.50	3,250	.....
Interest on plant at 6%	1,080	1,650
Depreciation found on boiler house plant:		
Coke—ten years at 7.95% per annum	1,430	.....
Electric—twenty years at 3.02% per annum	.....	845
Maintenance and renewals	750	150
Attendance	2,750	.....
Ash removal	150	.....
Total	$9,410	$9,520

Air Conditioning

III. Ventilation—General Discussion (*Continued*)

by **WILLIAM HULL STANGLE and HENRY WARREN KINGSBURY**

TO be strictly technical, we must carefully distinguish ventilation from air conditioning. Usage often does, as in the case of ventilation and air conditioning, develop phrases, definitions and practices, which are confusing even to the trained mind. Ventilation is so much a part of air conditioning that a sharp distinction between the two is, because of usage and habit, quite difficult. For the sake of the clearest possible understanding we will define ventilation as the supply, circulation and distribution of fresh air and the accumulation, circulation and removal of vitiated air. The removal of foreign matter such as dust and dirt by means of filters may be considered as a part of ventilation but borders on conditioning of air since we are doing something to the air that changes its characteristics.

Let us, therefore, say that when we do anything to air to change its characteristics, we condition the air. Such treatment of air may be filtration, heating, washing, cooling, etc. Ventilation on the other hand, as we have stated, is the movement of, and the handling of, air in its natural state. That is why the modern phrase "synthetic atmosphere" has been coined, since it is the man-made product resulting from conditioning air.

The earth is surrounded by an air envelope. This envelope travels around with the earth. The surface of the earth is not smooth and the cohesive and adhesive qualities of air are low, since air is a distinctly mobile, gaseous fluid. Naturally, with the earth's rough surface and the low "sticking" qualities of air there must result a considerable "slip" between the air envelope and the earth's surface. This results in the movement of air over the earth's surface causing winds. These winds play an important part in the elemental changes in weather conditions. They cause vitiated air, high in CO_2, to be moved to the regions of plant life where the CO_2 is converted to oxygen. They cause the movement of water vapor or clouds, which in the vapor state affect the humidity, and last, but not least, aid in the production of rainfall which is essential to plant and human life.

Ventilation had its beginning in the desire for all life to secure proper oxygen conditions concomitant to the requirements of the living being. Early animals, no doubt, learned the value of clean, healthy air.

Today, man recognizes a moving air stratum—a breeze. In the summer he seeks it because it gives him greater comfort. In the winter he avoids it to gain equal comfort. Why? Because in summer the breeze aids in the evaporation of the moisture envelope around his body, lowering the skin temperature and resulting in greater comfort. In winter, the heavier clothing holds the air envelope close to the body, the moisture content increases, the skin warms up and, in avoiding drafts, the body is protected and comfort results.

Milady's dainty Parisian fan seemingly aided in the local comfort where the movement of air was increased. But, the energy exerted produced excess heat and the actual result of seeming partial comfort was more psychological than physical.

The electric fan gives, to a degree, some relief and greater comfort during the torrid days, but greater discomfort results when drafts are produced in the development of head colds.

Numerous technical and legal requirements have been responsible for relatively fixed laws as to the requirements of ventilation. As most systems designed to meet these requirements require heating or cooling of air or humidifying or dehumidifying, the subject matter will be discussed in a subsequent article on air conditioning itself.

Briefly, a ventilation system comprises a fresh air supply, a supply fan to move the required amount of air, a distribution system of ducts to convey the air to the proper place for ultimate distribution, and outlets of proper size and design to cause the best diffusion of the air supply to the space being treated. A complete exhaust system is essential, comprising inlets, collecting ducts to convey the vitiated air to the exhauster, an exhaust fan to expel the vitiated air and a vitiated air exhaust. No ventilation system can be considered worthy of the name that is merely a supply system or, on the other hand, merely an exhaust system; both supply and exhaust systems should be installed.

Dirt screens, supply, filters, heaters, washers, refrigeration plants, controls and apparatus in general for air conditioning will be discussed in subsequent articles. A separate article will discuss diffusion of air, another, fans and drive, another, distribution systems, and still another, outlets and inlets.

Erratum

In the Fundamental Physical Data on page 82 of the July issue the number of inches of water per pound per square inch pressure was incorrectly derived. It was stated that 0.491 in. of mercury equals a pressure of 1 lb. per sq. in. and from this was derived the figure 7.6776 as the number of inches of water indicating a pressure of 1 lb. per sq. in.

The correct derivation should have been based on the fact that 1 in. of mercury equals a pressure of 0.491 lbs. per sq. in. From this it can be shown that 1 lb. per sq. in. is equal to 27.71 in. of water (instead of 7.6776), and that 1 in. of water equals 0.036 lbs. per sq. in. (instead of 0.13125).

FUNDAMENTAL PHYSICAL DATA

Supplementing "Air Conditioning" by William Hull Stangle and Henry Warren Kingsbury

Water. In the very beginning of things the earth was a gaseous nebula. As the gases cooled, one of the salts to be condensed and further solidified was sodium chloride (common table salt). But, this salt was a solid long before the gases making up water vapor were cooled sufficiently to be precipitated as rain. When fluid or liquid water finally resulted, the salt dissolved in it, and to this day the oceans are but huge pools of saline solution.

Water is the universal solvent. The atmosphere is, physically speaking, a huge condenser. Water at the equator is carried into the upper regions and because of air currents, caused by the earth's rotation, is carried to the temperate zones where it precipitates as rain, fog, or dew and at the polar regions or in high altitudes deposits as snow or sleet.

Now, in passing through the atmosphere, water dissolves oxygen and carbon dioxide. When it again reaches the earth these substances are in solution. It is this that distintegrates the carbonates (chalks) and the silicates (sands). The chalk is carried away in solution as a lime bi-carbonate and the sands or muds are carried away as fine particles. In fact, the sand and mud particles are so fine they do not readily settle out and are said to be in "semi-colloidal" solution. This mud is a source of great trouble in the operation of boilers and condensers. It cannot be readily filtered out and coagulents, such as alum, have to be used.

Principal soluble impurities carried by water are silica, carbonate of lime, sulphate of lime, carbonate of soda, carbonate of potash, chloride of sodium, alumina and oxide of iron, carbonate of magnesium, sulphate of magnesia, nitrate of lime, nitrate of magnesium, nitrate of sodium, chloride of calcium and chloride of magnesium. Waters containing some of these salts, are called *hard* waters. All of these dissolved substances are obtained by the water in its passing over or through the ground. They are obtained either by direct solution or through chemical reaction in the forming of hydrates, which in turn react to form the more stable salts, or they are the result of the mineral bases reacting with the carbonates, chlorides, nitrates, etc., that are absorbed.

When these substances are affected by heat in the making of steam in boilers, they either concentrate or dissociate, forming scale and deposits in the boiler tubes resulting in incrustation and deterioration. Some are carried over in the steam and find their way into the piping, heaters, and condensers.

Pure water is a chemical compound formed of two volumes of hydrogen gas with one volume of oxygen gas. The chemical formula is H_2O. It is made up of 2 parts of hydrogen and 16 parts of oxygen, by weight.

Water exists as a liquid between + 32° F., = (0° C.) and + 212° F. (100° C.) Below the lower temperature it is a solid, ice. Above the higher temperatures it is a gaseous fluid, steam.

Water expands, when heated, from 32° to 39.2° and contracts above 39.2° F. The change in density is indicated by the following weights per cu. ft. at various temperatures:

At 32° F. (freezing point).....62.418 lbs. per cu. ft.
At 39.2° F. (maximum density).....62.427 lbs. per cu. ft.
At 62° F. (standard temperature).....62.355 lbs. per cu. ft.
At 212° F. (boiling point), the weight is.....59.760 lbs. per cu. ft.

A U. S. gallon contains 231 cu. in. of water at 62° F. The water in a U. S. gallon weighs 8-1/3 lbs. A cubic foot is equal to 7.48 (usually figured at 7.5) gal.

Mechanics of Liquids. Water is a typical liquid. The study of liquids in motion is called hydraulics. The study of liquids at rest is called hydrostatics.

TABLE 10—HEAT CONTENT AND SPECIFIC WEIGHT OF WATER*
(At Atmospheric Pressure)

Temperature, Degrees F.	Heat Content above 32° per Pound	Weight, Pounds per Cubic Foot	Temperature, Degrees F.	Heat Content above 32° per Pound	Weight, Pounds per Cubic Foot
32	0.00	62.42	128	95.92	61.60
35	3.02	62.42	130	97.91	61.56
40	8.05	62.42	132	99.91	61.52
45	13.07	62.42	134	101.90	61.49
50	18.08	62.41	136	103.90	61.45
52	20.08	62.40	138	105.90	61.41
54	22.08	62.40	140	107.89	61.37
56	24.08	62.39	142	109.89	61.34
58	26.08	62.38	144	111.89	61.30
60	28.08	62.37	146	113 89	61.26
62	30.08	62.36	148	115.88	61.22
64	32.08	62.35	150	117.88	61.18
66	34.08	62.34	152	119.88	61.14
68	36.08	62.33	154	121.88	61.10
70	38.07	62.31	156	123.88	61.06
72	40.07	62.30	158	125.88	61.02
74	42.07	62.28	160	127.88	60.98
76	44.06	62.27	162	129.87	60.94
78	46.06	62.25	164	131.87	60.90
80	48.05	62.23	166	133.86	60.85
82	50.05	62.21	168	135.88	60.81
84	52.04	62.19	170	137.88	60.77
86	54.04	62.17	172	139.88	60.73
88	56.03	62.15	174	141.88	60.68
90	58.03	62.13	176	143.89	60.64
92	60.02	62.11	178	145.89	60.59
94	62.02	62.09	180	147.89	60.55
96	64.01	62.07	182	149.89	60.50
98	66.01	62.05	184	151.90	60.46
100	68.00	62.02	186	153.90	60.41
102	69.99	62.00	188	155.91	60.37
104	71.99	61.97	190	157.91	60.32
106	73.98	61.95	192	159.92	60.27
108	75.97	61.92	194	161.92	60.22
110	77.97	61.89	196	163.93	60.17
112	79.96	61.86	198	165.94	60.12
114	81.96	61.83	200	167.95	60.07
116	83.95	61.80	202	169.95	60.02
118	85.94	61.77	204	171.96	59.97
120	87.94	61.74	206	173.97	59.92
122	89.93	61.70	208	175.98	59.87
124	91.93	61.67	210	177.99	59.82
126	93.92	61.63	212	180.00	59.76

*Reprinted by permission from "Properties of Steam and Ammonia," by Goodenough, published by John Wiley & Sons, Inc.

Since a liquid is a fluid, having volume but taking the form of the container in which it is placed, it evidently must exert a pressure against the bottom and sides of the container. If a substance is placed in the liquid, it is buoyed up by the liquid. If the unit volume of the substance weighs less than a similar volume of liquid the substance will float. If the substance is heavier than an equivalent volume of liquid, the substance in the liquid will weigh the difference between the weight of the dry substance and the liquid volume equivalent. From this it is evident that a liquid also exerts an upward pressure.

Previously we have defined force as a push or pull, measured as pressure in grams per square centimeter or pounds per square foot or square inch.

Liquid pressure is proportional to the depth of the liquid. An analogy of this may be visualized by a brick lying on a board. One brick will exert a pressure equal to the weight of one brick. Two bricks will exert twice the pressure, three bricks three times the pressure, etc. In addition, each brick sustains the weight of the bricks above. So, with water, each layer sustains the weight above, and the downward pressure is the summation of the weights above. From this we establish the fact that the pressure of a liquid must increase in *direct* proportion to the depth.

As an example, if the liquid weighs 62.355 lbs. per cu. ft. (the weight of water at 62° F.) 1 ft. in depth will produce a pressure of 62.355 lbs., two feet in depth will produce a pressure of 144.71 lbs. per sq. ft. With a height of 12 in., the area at the base is 144 sq. in., so that 62.355/144 = 0.433 lbs. per sq. in. pressure per foot of height. For 1 ft. in height the pressure in pounds per square inch is 0.433; for 2 ft., it is 0.433 × 2 = 0.866, etc., etc. For any other liquid than water substitute the weight in pounds per cubic foot and solve in the same manner.

Liquid pressure is directly proportional to density. If a substance (liquid) has a density twice that of water then the pressure it will exert is twice that of water. Formulated, we have, pressure = depth × density, or $p = hd$, where P = pressure, h = depth and d = density.

Liquid pressure is independent of direction. In the brick analogy we note that bricks are solids, whereas liquids are fluids. The pressure of the bricks could only be downward, but the pressure of a liquid is in all directions.

Liquid pressure is independent of the shape or area of a container, since the liquid pressure is proportional to the depth and the density of the liquid.

Since pressure is the force acting on unit area, the total force acting on the bottom of a container, due to a given depth of liquid, is equal to the product of area × pressure, or total force = area × depth × density. Formulated, we have $F = Ahd$, where F = total force, A = area, h = depth, and d = density.

When it is necessary to calculate the total pressure on the entire side of a containing vessel, the depth is taken as the average, resulting in the formula,

$$F = \frac{Ahd}{2}$$

Liquids will always seek their level.

Flow of Water in Pipes. Flow of water in pipes is dependent upon the difference in head or pressure between the two points between which flow takes place. This difference in head is used up in overcoming the frictional resistance of the water flowing through the pipe and in creating the velocity of discharge at the discharge opening.

In the previous article the definitions of static, velocity and total or dynamic pressures were given. The flow of a liquid in a pipe (in this case water) is influenced by these three pressures, or heads. It is well, at this time to understand that "head" and "pressure" are synonymous, i.e., that the "head" in feet of a liquid has a definite relative value in pounds per square inch. Of course, other units may be used, such as meters "head" and grams per square centimeter, but the definitive relations always exist.

Resistance head, pressure head or frictional head is the head or pressure required to overcome the frictional resistance of the liquid flowing through the pipe. It is commonly referred to as the static pressure or head.

Velocity head or pressure head is the head or pressure required to create the velocity at a given point. It is the pressure required to accelerate the mass of liquid from a state of rest to the velocity existing at the point designated.

Dynamic head is the sum of the static head and the velocity head and is the pressure required to overcome the friction loss from the first point to the second point and produce the required velocity at the second point.

Energy has been previously stated as of two kinds; kinetic or potential. Since water or a liquid is mass, the potential or measured head is the vertical distance, measured in feet, from some datum line to a point in the line of pipe under consideration or observation.

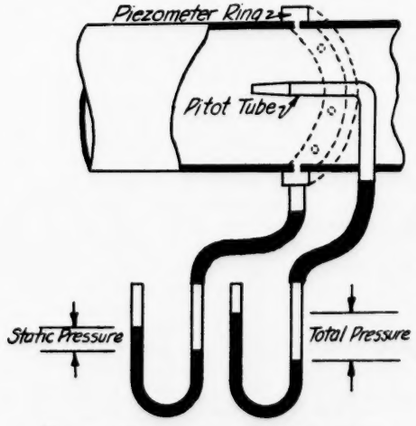


Fig. 8. Piezometer and Pitot Tube

Static pressures are usually measured by means of the piezometer. For high pressures, the Bourdon or spring gage is used.

Total pressures are usually measured by means of the Pitot tube.

The difference between the total pressure and the static pressure is the velocity pressure or head. Fig. 8 shows the application of these instruments.

Bernoulli's Theorem. If there were no friction in the flow of liquids "the total head at any point or section would be equal to the total head at any subsequent point or section." In the previous article the total head was defined as the sum of the static head plus the velocity head.

In explanation two conditions will be analyzed. In the first condition "flow without friction" will be considered as following Bernoulli's Theorem. In the second condition the factor of friction loss will be considered as "flow with friction."

Under the first condition, referring to Fig. 9, the pressure P at A is atmospheric and at B is also atmospheric. The velocity at A is 0, hence, if D equals the density of the fluid,

$$0 + H + \frac{P}{D} = \frac{V^2}{2g} + 0 + \frac{P}{D}$$

Therefore, $H = \frac{V^2}{2g}$ or $V = \sqrt{2gH}$

Under the second condition, referring to Fig. 9, the total head at any section or point is greater than at any subsequent section or point since friction opposes motion. The "friction head" between any two points is the difference between the total heads.

Total head at A $= 0 + H + \frac{P}{D}$, as above.

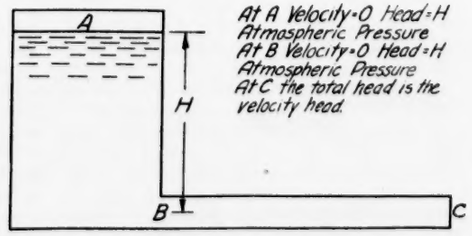


Fig. 9. Relation Between Total, Static and Velocity Heads With and Without Friction

Fundamental Physical Data (*Continued*)

$$\text{Total head at C} = \frac{V^2}{2g} + 0 + \frac{P}{D}$$

$$\text{Friction head} = \left(0 + H + \frac{P}{D}\right) - \left(\frac{V^2}{2g} + 0 + \frac{P}{D}\right) = H - \frac{V^2}{2g}$$

Thermal Properties of Water. We have already discussed the specific heat, or quantity factor, of water equals 1; the standard weight of a cubic foot has been established as 62.355 lbs.; the heat unit has been established and the boiling point at sea level under a normal pressure of one atmosphere fixed at 212° F. or 100° C.

We know that the atmospheric pressure reduces as altitude above sea level is gained. Table 11 gives the Boiling Point of Water at Various Altitudes.

TABLE 11
BOILING POINT OF WATER AT VARIOUS ALTITUDES

Boiling Point, Deg. F.	Altitude Above Sea Level, Ft.	Atmospheric Pressure, Lbs. per Sq. In.	Barometer Reduced to 32°, In.
184	15,221	8.20	16.70
185	14,649	8.38	17.06
186	14,075	8.57	17.45
187	13,498	8.76	17.83
188	12,934	8.95	18.22
189	12,367	9.14	18.61
190	11,799	9.34	19.02
191	11,243	9.54	19.43
192	10,685	9.74	19.85
193	10,127	9.95	20.27
194	9,579	10.17	20.71
195	9,031	10,39	21.15
196	8,481	10.61	21.60
197	7,932	10.83	22.05
198	7,381	11.06	22.52
199	6,843	11.29	22.99
200	6,304	11.52	23.47
201	5,764	11.76	23.95
202	5,225	12.01	24.45
203	4,697	12.26	24.96
204	4,169	12.51	25.48
205	3,642	12.77	26.00
206	3,115	13.03	26.53
207	2,589	13.30	27.08
208	2,063	13.57	27.63
209	1,539	13.85	28.19
210	1,025	14.13	28.76
211	512	14.41	29.33
212	Sea Level	14.70	29.92

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The specific heat of water varies slightly according to its temperature. This is indicated by Table 12.

TABLE 12
SPECIFIC HEAT OF WATER AT VARIOUS TEMPERATURES

Temperature, Deg. F.	Specific Heat
20	1.0210
30	1.0104
40	1.0048
50	1.0015
60	0.9995
70	0.9982
80	0.9975
90	0.9971
100	0.9970
110	0.9971
120	0.9974
130	0.9978
140	0.9984
150	0.9990
160	0.9998
170	1.0007
180	1.0017
190	1.0028
200	1.0039
210	1.0052
220	1.0068
230	1.0085

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Since the specific heat of water may for all practical purposes be taken as 1, the heat of the liquid or heat content for a given temperature differential may be estimated as the difference in degrees F. per pound of water, expressed in B.T.U. For example, 12 lbs. of water raised from 40° F. to 60° F. will require 12 lbs. (60° — 40°) = 240 B.T.U. In practical problems the heat content is usually calculated from the freezing point, 32° F.

Practically, water freezes at 32° F. and boils at 212° F., a differential of 180° at atmospheric pressure. At other pressures this differential changes. This differential can be measured by the thermometer and is called "sensible" heat.

Whenever a substance changes its physical state, that is, changes from a solid to a liquid or from a liquid to a gas, extra work must be done to overcome the molecular cohesion or tendency of the molecules to remain in the then existing state. It is a form of molecular inertia that must be overcome.

Since work is energy, then energy must be added to change the physical state and in this case it is heat that must be added.

When water is heated to the boiling point the water does not boil until this extra heat is added. Although extra heat is added the temperature does not rise above the temperature of the boiling point and since the added heat cannot be directly measured by thermometry, i.e., is not "sensible heat," this added heat is called "latent" heat.

When a pound of ice at 32° F. is changed into water at 32° F., there are required 144 B.T.U.'s to produce the change in physical state. This is known as the latent heat of fusion. The temperature 32° is known as the melting point of ice or the freezing point of water. Water can be supercooled below 32° and, because of this phenomenon in science, the freezing point is rarely referred to, but the melting point of ice, being more constant, is the phrase popularly referred to by engineers. The specific heat of ice is given as approximately 0.504 B.T.U. per lb.

Vapor Pressure and Aqueous Tension. The quantity of vapor given off by a liquid is defined by the gaseous pressure it exercises. This is called the vapor pressure of the liquid.

A significant characteristic of vapor pressure is that when an excess of the liquid is present, the pressure of the vapor rapidly reaches a maximum for each temperature. When there is a deficiency of the liquid, less than the maximum pressure may exist. An excess of vapor above the maximum for a given temperature will result in a condensation of the excess vapor to maintain the balance.

Maximum vapor pressure is held to represent the vapor tension of the liquid, at the given temperature. Since, to maintain an equilibrium, the vapor tension is the movement of the water vapor molecules into the space above the liquid, so the vapor pressure is the movement of the mo'ecules in all directions and back into the liquid to maintain this balance. When there is an excess of liquid the vapor tension, in the case of water, is called the aqueous tension. When the full amount of vapor, for a given temperature, exists the air is said to be saturated. This is kindred to 100% humidity.

Air above the surface of the earth is always under a vapor pressure of some degree and in general is two-thirds saturated with water vapor.

TABLE 13—VAPOR PRESSURES OF WATER

Temperature, °F.	Tension of Water Vapor In. Mercury	Temperature, °F.	Tension of Water Vapor In. Mercury
0	0.0375	20	0.1027
2	0.0417	22	0.1130
4	0.0462	24	0.1242
6	0.0512	26	0.1365
8	0.0567	28	0.1499
10	0.0628	30	0.1646
12	0.0694	32	0.1806
14	0.0766	34	0.1957
16	0.0846	36	0.2119
18	0.0932	38	0.2292

TABLE 13—VAPOR PRESSURES OF WATER (Continued)

Temperature, °F.	Tension of Water Vapor In. Mercury	Temperature, °F.	Tension of Water Vapor In. Mercury
40	0.2478	128	4.282
42	0.2678	130	4.52
44	0.2891	132	4.76
46	0.3120	134	5.02
48	0.3364	136	5.29
50	0.3624	138	5.58
52	0.3903	140	5.88
54	0.4200	142	6.18
56	0.4517	144	6.51
58	0.4855	146	6.84
60	0.5214	148	7.20
62	0.5597	150	7.57
64	0.6005	152	7.95
66	0.6438	154	8.34
68	0.6898	156	8.76
70	0.7386	158	9.20
72	0.7906	160	9.65
74	0.8456	162	10.12
76	0.9040	164	10.61
78	0.9658	166	11.12
80	1.031	168	11.65
82	1.101	170	12.20
84	1.174	172	12.77
86	1.251	174	13.37
88	1.334	176	13.98
90	1.421	178	14.62
92	1.512	180	15.29
94	1.609	182	15.98
96	1.710	184	16.70
98	1.818	186	17.45
100	1.931	188	18.22
102	2.045	190	19.02
104	2.171	192	19.85
106	2.303	194	20.71
108	2.443	196	21.60
110	2.589	198	22.52
112	2.740	200	23.47
114	2.904	202	24.45
116	3.073	204	25.48
118	3.252	206	26.53
120	3.438	208	27.63
122	3.635	210	28.76
124	3.841	212	29.92
126	4.057		

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Physical Properties of Steam. Steam is water that has changed from the fluid liquid state to the fluid gaseous or vapor state. This change is accomplished by adding sufficient sensible heat to raise the water to the boiling point and latent heat to change the liquid into vapor. For every individual pressure this change takes place at a definite and constant temperature. The boiling of a liquid is called ebullition.

Saturated Steam. Steam that is in contact with the water from which it was generated is called saturated steam. Saturated steam may be "dry" or "wet." Wet saturated steam contains water in the form of a mist.

Superheated Steam. Dry saturated steam when heated under a maintained or constant pressure, becomes higher in temperature. This is called superheated steam. As in all other substances, the heating of steam to superheat it, (as well as other gaseous fluids) depends on the quantity factor, the specific heat, and the intensity factor, the temperature differential. The specific heat of steam (or of any gaseous fluid) is constant only for a definite pressure. There is a specific heat for each individual pressure.

Generation of Steam. Since energy is motion and heat is a form of energy, any substance to which heat is added or increased must have some sort of molecular motion. As has been previously stated, absolute zero (— 459.6° F. or — 273.1° C.) is the point at which all molecular vibration ceases. If heat were added to ice at this point, the heat would cause a molecular vibration, which, although imperceptible to the eye, would, on being increased, cause the ice to expand. With added heat the ice could be "warmed" to + 32° F., the melting point of ice. At this point all the sensible heat from — 459.6° F. up through 0° to +32° F. could be directly measured. But, at the melting point of ice a physical change from the solid "ice" to the liquid fluid "water" will take place if the latent heat of fusion is added. When this has been added the ice changes to water. Now, what really happened was the breaking up of the molecular cohesion of the solid molecules. The water has the same molecules but they are more widely separated and held in equilibrium by the heat energy content. From + 32° F., the water can be heated up to 212° F. or the boiling point. Now, again, at 212° F. a physical change would take place if the latent heat of evaporation were added. The molecular cohesion of the water molecules would be overcome and steam or water vapor molecules would exist. These, too, would be the same molecules of water or ice (H_2O) but in a more energetic condition, i.e., having more motion, all held in equilibrium by the heat energy content.

If saturated steam were heated it would become superheated and rise in temperature up to a point of dissociation of the H_2O molecule which, however, would only take place at exceedingly high temperatures. At 2000° C. the dissociation is only 1.8%.

Most machines make use of the pressure of steam while heating takes advantage of the heat content of the steam. Excellent efficiencies can be obtained with high pressure steam, and with turbines where the heat content enters into the operation, superheated steam increases the efficiency. Heating systems usually operate at low-pressure differentials.

Quality of Steam. The proportion of dry steam to the pound of steam delivered by the boiler is termed the quality of the steam. It is represented by the symbol x. The heat of the steam above + 32° F. is denoted as Hx and is equal to $q + xr$.

The volume of 1 lb. of steam is the specific volume, v. The specific volume decreases as the pressure increases. The reciprocal $\frac{1}{v}$ denotes the weight of steam per cubic foot and is known as the density of steam, d.

Total heat of steam for any pressure and temperature is equal to the sum of the sensible heat required to raise 1 lb. of water from the freezing point to the boiling point, at the designated pressure, plus the latent heat of vaporization required to vaporize it at the designated pressure, plus the heat required to superheat the steam to the temperature designated at the designated pressure.

Total heat of dry saturated steam is the same as described above except the heat required for superheating is not added since there is no superheating.

With wet saturated steam the total heat at any pressure and temperature is the sum of the heats required to raise the temperature of one pound of water

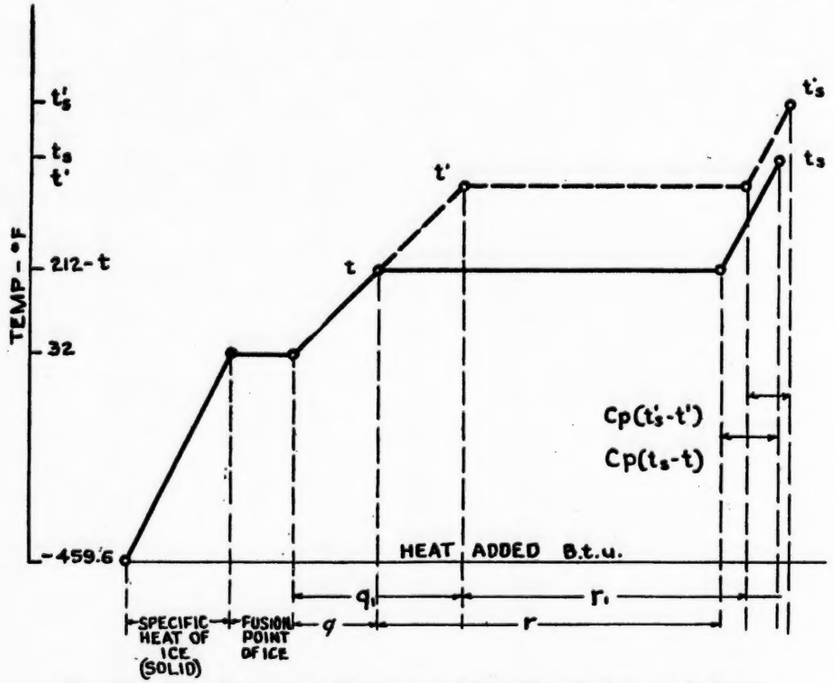

Fig. 10. Heat Content of Water as a Solid, Liquid, Saturated Vapor and Superheated Vapor

from the freezing point to the boiling and to vaporize the part x at the pressure corresponding to the boiling point. Formulated, this is

$$H_x = xv + q.$$

Superheated steam is water vapor that has been heated (when *not* in contact with the liquid from which it was formed) until it is at a temperature higher than saturated steam at the same pressure. If the degree of superheat is much higher than saturated steam at the same pressure, the superheated steam will closely follow the law of perfect gases.

The relation between pressure, volume and temperature of superheated steam has been formulated as $V + 0.256 = 0.5962 \frac{T}{P}$, where V is specific volume, T is absolute temperature, and P is pressure in pounds per square inch.

Specific heat of steam is not constant. Mean specific heats of superheated steam are indicated in Fig. 11.

Heat content of superheated steam, previously described, may be formulated as:

$$H_s = q + r + C_p\,(t_s - t) = H + C_p\,(t_s - t), \text{ where}$$

t_s = temperature of superheated steam; t = temperature of saturated vapor at the corresponding pressure, q= heat of liquid at temperature t; r = heat of vaporization at temperature t; C_p = mean specific heat of superheated vapor; H = total heat of one pound of dry saturated steam, and H_s = total heat of one pound of superheated steam.

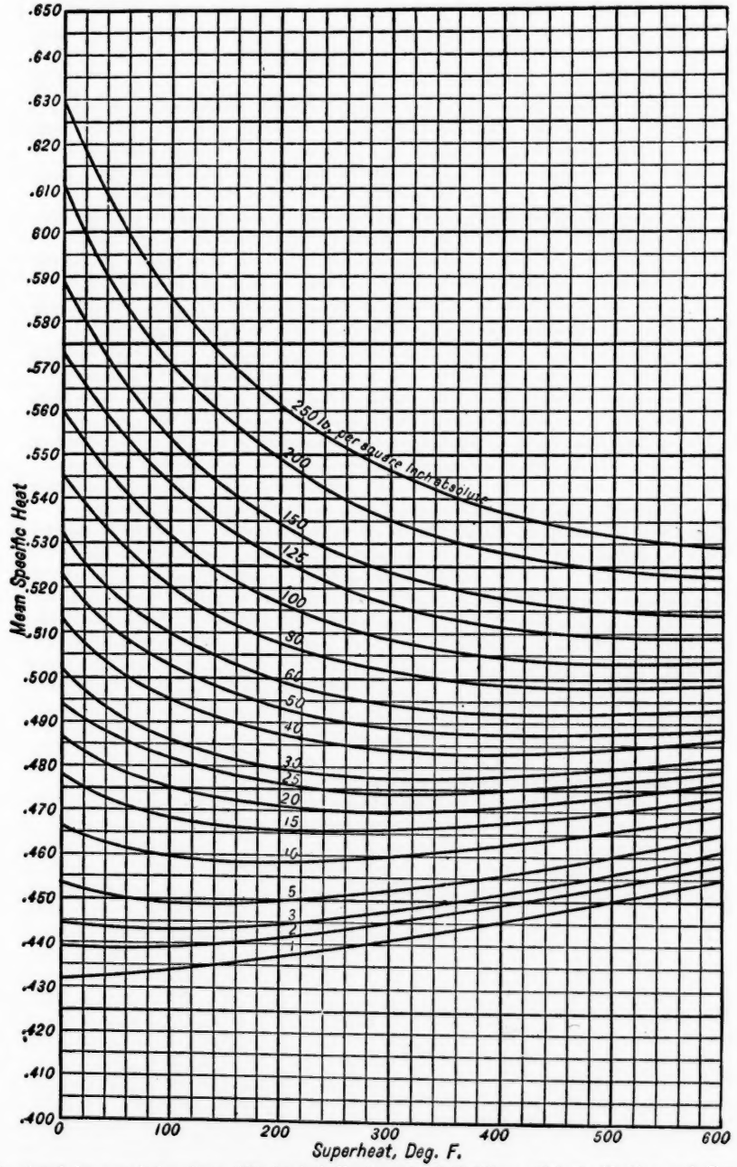

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Fig. 11. Mean Specific Heat of Superheated Steam (G. A. Goodenough)

Fundamental Physical Data (*Continued*)

TABLE 14—PROPERTIES OF SATURATED STEAM

Pressure		Temp. °F.	Volume, cu. ft. per lb.	Weight, lb. per cu. ft.	Heat content in B.T.U.		Latent heat in B.T.U.		Energy in B.T.U.	Entropy		
In. of mercury	Lb. per sq. in.				of liquid	of vapor	of vaporization	Internal		of liquid	of vaporization	of vapor
6.102	3	141.49	118.7	0.00843	109.38	1122.9	1013.5	947.6	1057.0	0.2009	1.6862	1.8871
8.144	4	152.99	90.6	0.01104	120.9	1127.9	1007.0	939.9	1060.7	0.2199	1.6438	1.8637
10.180	5	162.25	73.5	0.01360	130.1	1131.7	1001.6	933.6	1063.7	0.2348	1.6107	1.8456
12.216	6	170.07	62.0	0.01614	137.9	1135.0	997.1	928.2	1066.2	0.2473	1.5835	1.8308
14.25	7	176.85	53.7	0.01864	144.7	1137.8	993.1	923.6	1068.3	0.2581	1.5603	1.8184
16.29	8	182.87	47.35	0.02112	150.8	1140.3	989.5	919.4	1070.2	0.2675	1.5402	1.8077
18.32	9	188.28	42.41	0.02358	156.2	1142.5	986.3	915.6	1071.8	0.2759	1.5223	1.7982
20.36	10	193.21	38.43	0.02602	161.1	1144.4	983.3	912.2	1073.3	0.2835	1.5062	1.7897
22.40	11	197.75	35.16	0.02844	165.7	1146.2	980.5	909.0	1074.6	0.2905	1.4916	1.7821
24.43	12	201.96	32.41	0.03086	169.9	1147.9	978.0	906.0	1075.9	0.2969	1.4783	1.7752
26.47	13	205.88	30.07	0.03326	173.8	1149.4	975.6	903.2	1077.0	0.3028	1.4659	1.7687
28.50	14	209.56	28.06	0.03564	177.5	1150.8	973.3	900.6	1078.1	0.3083	1.4545	1.7628
30	14.74	212.13	26.75	0.03739	180.1	1151.8	971.7	898.8	1078.9	0.3122	1.4465	1.7587

Pressure, lb. per sq. in.	Temp., °F.	Volume, cu. ft per lb.	Weight, lb. per cu. ft.	Heat content in B.T.U.		Latent heat in B.T.U.		Energy in B.T.U.	Entropy		
				of liquid	of vapor	of vaporization	Internal		of liquid	of vaporization	of vapor
15	213.0	26.30	0.03802	181.0	1152.2	971.2	898.1	1079.1	0.3135	1.4438	1.7573
20	228.0	20.10	0.0498	196.0	1157.7	961.7	887.3	1083.3	0.3356	1.3987	1.7343
25	240.1	16.32	0.0613	208.2	1162.1	953.8	878.4	1086.5	0.3531	1.3633	1.7164
30	250.3	13.76	0.0727	218.6	1165.7	947.1	870.7	1089.2	0.3679	1.3340	1.7019
35	259.3	11.91	0.0840	227.7	1168.7	941.0	863.9	1091.5	0.3805	1.3090	1.6895
40	267.2	10.51	0.0951	235.8	1171.3	935.5	857.8	1093.4	0.3917	1.2871	1.6788
45	274.4	9.41	0.1062	243.1	1173.6	930.5	852.2	1095.2	0.4017	1.2677	1.6694
50	281.0	8.53	0.1173	249.8	1175.6	925.9	847.1	1096.7	0.4108	1.2501	1.6609
55	287.1	7.80	0.1283	255.9	1177.5	921.5	842.3	1098.0	0.4190	1.2342	1.6532
60	292.7	7.18	0.1392	261.7	1179.1	917.4	837.8	1099.3	0.4267	1.2195	1.6462
65	298.0	6.66	0.1501	267.1	1180.6	913.5	833.5	1100.4	0.4338	1.2058	1.6397
70	302.9	6.22	0.1609	272.2	1182.0	909.8	829.5	1101.4	0.4405	1.1931	1.6336
75	307.6	5.82	0.1717	277.0	1183.3	906.2	825.6	1102.4	0.4468	1.1812	1.6280
80	312.0	5.48	0.1824	281.6	1184.4	902.8	821.9	1103.2	0.4527	1.1700	1.6227
85	316.3	5.18	0.1932	286.0	1185.5	899.6	818.4	1104.1	0.4583	1.1595	1.6178
90	320.3	4.905	0.2039	290.1	1186.5	896.4	815.0	1104.8	0.4636	1.1495	1.6131
95	324.1	4.663	0.2145	294.1	1187.5	893.4	811.7	1105.5	0.4687	1.1400	1.6087
100	327.8	4.442	0.2251	297.9	1188.4	890.5	808.6	1106.2	0.4736	1.1309	1.6045
105	331.4	4.240	0.2358	301.6	1189.2	887.6	805.5	1106.8	0.4782	1.1222	1.6004
110	334.8	4.057	0.2465	305.1	1190.0	884.8	802.6	1107.3	0.4827	1.1138	1.5965
115	338.1	3.889	0.2572	308.6	1190.7	882.1	799.7	1107.9	0.4870	1.1058	1.5928
120	341.3	3.735	0.2678	311.9	1191.4	879.5	796.9	1108.4	0.4911	1.0982	1.5893
125	344.4	3.593	0.2783	315.1	1192.0	876.9	794.2	1108.8	0.4950	1.0908	1.5858
130	347.4	3.461	0.2889	318.2	1192.6	874.4	791.6	1109.3	0.4989	1.0836	1.5825
135	350.3	3.340	0.2994	321.2	1193.2	872.0	789.0	1109.7	0.5026	1.0767	1.5793
140	353.1	3.226	0.3100	324.2	1193.7	869.6	786.4	1110.1	0.5062	1.0700	1.5762
145	355.8	3.120	0.3206	327.0	1194.2	867.2	784.0	1110.5	0.5097	1.0636	1.5733
150	358.5	3.020	0.3311	329.8	1194.7	864.9	781.6	1110.9	0.5131	1.0573	1.5704
155	361.1	2.927	0.3417	332.5	1195.2	862.7	779.2	1111.2	0.5164	1.0512	1.5676
160	363.6	2.839	0.3522	335.2	1195.7	860.5	776.9	1111.5	0.5196	1.0453	1.5649
165	366.1	2.757	0.3627	337.8	1196.1	858.3	774.6	1111.8	0.5227	1.0395	1.5622
170	368.5	2.679	0.3733	340.3	1196.5	856.2	772.4	1112.1	0.5258	1.0339	1.5597
175	370.8	2.605	0.3838	342.8	1196.9	854.1	770.2	1112.4	0.5287	1.0284	1.5572
180	373.1	2.536	0.3943	345.2	1197.2	852.0	768.0	1112.7	0.5316	1.0231	1.5547
185	375.4	2.470	0.4048	347.6	1197.6	849.9	765.9	1112.9	0.5344	1.0179	1.5523
190	377.6	2.408	0.4154	350.0	1197.9	847.9	763.9	1113.2	0.5372	1.0128	1.5500
195	379.7	2.348	0.4259	352.2	1198.2	846.0	761.8	1113.4	0.5399	1.0079	1.5478
200	381.9	2.292	0.4364	354.5	1198.5	844.0	759.8	1113.6	0.5426	1.0030	1.5456
205	383.9	2.238	0.4469	356.7	1198.7	842.1	757.8	1113.8	0.5451	0.9983	1.5434
210	386.0	2.186	0.457	358.8	1199.0	840.2	755.9	1114.0	0.5477	0.9936	1.5413
215	388.0	2.137	0.468	361.0	1199.2	838.3	754.0	1114.2	0.5502	0.9890	1.5392
220	390.0	2.090	0.478	363.0	1199.5	836.5	752.1	1114.3	0.5526	0.9846	1.5372
225	391.9	2.045	0.489	365.1	1199.7	834.6	750.2	1114.5	0.5550	0.9802	1.5352
230	393.8	2.002	0.499	367.1	1199.9	832.8	748.3	1114.6	0.5573	0.9760	1.5333
240	397.5	1.921	0.521	371.0	1200.3	829.3	744.7	1114.9	0.5619	0.9676	1.5295
250	401.1	1.846	0.542	374.9	1200.6	825.8	741.2	1115.2	0.5663	0.9595	1.5258

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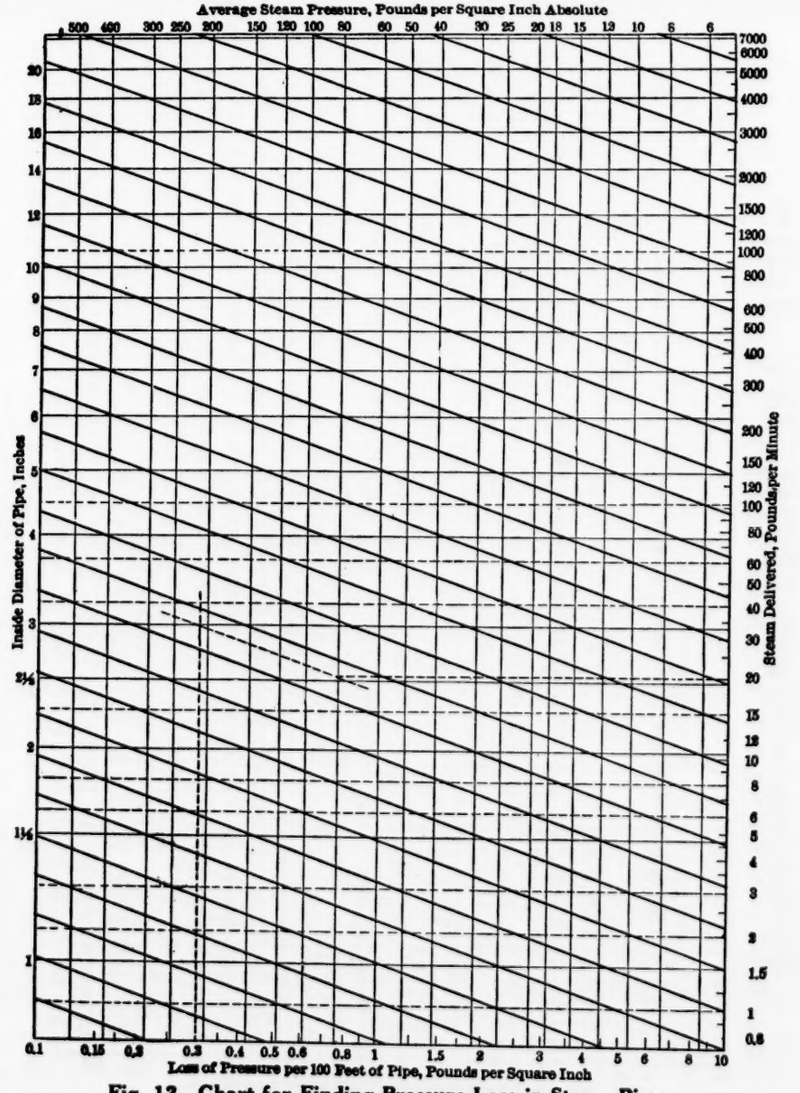

Fig. 12. Chart for Finding Pressure Loss in Steam Pipes (Prof. H. V. Carpenter)

Steam Flow Chart. The use of steam flow charts is common practice today. Fig. 12 is a chart showing the size pipe, average steam pressure, loss of pressure and steam delivered.

(*To be continued*)

House-Heating by Gas

Gas Conversion Burners (*Continued*)

by C. GEORGE SEGELER

Industrial Editor, American Gas Association

Classification of Automatic Gas Burners

TO clarify the comparison of automatic gas burners, they can be segregated into the following types:

1. Elementary Atmospheric Burners.

(a) The simplest burners are drilled pipe burners, merely set into the firebox. No attempt is made to control excess air, and no refractories are used.

(b) Special shapes of atmospheric burners. These include large volume flame burners of the single port type, as well as the multi-port type. Minor variations in construction include differences in the method in which primary air for combustion is mixed with the gas. Very often baffling of the flue passages of the boiler is resorted to, in order to increase the scrubbing effect.

(c) Two modifications of the above system include the flames playing down on a refractory bed, and flames playing under a refractory bed. The latter type has many disadvantages, and is gradually disappearing from use. These burners are the simplest to use, but they provide for no control of excess secondary air, and although they are usually installed without any attempt to check the flue gas composition or temperature, they are the burners which most need such control. Poor installations of this class of burner have given the entire conversion systems a serious setback, because of the low operating efficiency. Some of these burners have a gauze in them, but this is likely to be stopped up by dust or by flash back, and then serious trouble will be encountered.

Refractory burners should be so designed that refractory breaking down due to long exposure at high temperatures will not fall on the burner ports and close them up.

Burners installed so that they point downward sometimes cause small quantities of unburned gas to escape on shutting off the main burner. This quantity, while not in any way harmful, may escape into the cellar and cause a disagreeable odor.

2. Burners with Secondary Air Control.

(a) In order to improve operating efficiencies, some of the better makes of automatic gas burners are provided with secondary air controls. This type can be operated with very high efficiencies.

(b) Burners placed in close proximity to the heating surface. Of all atmospheric type burners, those placed in close proximity to the heating surface, and combined with secondary air control, are giving the best results. That is quite natural, because the heat is applied where it can do the most good. These systems make use of a refractory or metal wall forming an annular space next to the firepot walls, in which the burners are located. As a result, the secondary air can be kept down to minimum values, especially as the burners have been very carefully designed with suitable Venturi mixing tubes and properly machined gas orifices.

In this connection it should be recognized that gas flames, even when non-luminous, possess quite some radiant energy, so that even without the presence of refractories in the flame, there will be a considerable portion of the heat transferred from a gas flame to the direct heating surface. Claims made for increase in efficiency because of the presence of refractory have not been substantiated. As far as evidence is available at this time, the purpose of refractory is to increase the proportion of heat transmitted by radiant energy. There is no reason to suspect that this will have any effect on the overall efficiency of an automatic gas burner. If the heat of a gas flame is removed by the processes of conduction, convection and radiation, concentrated into a radiant, and reradiated directly to the heating surface in the firebox, then the heat left behind for absorption by the indirect heating surface is just that much less.

Refractories Do Not Necessarily Raise Efficiency

Heat transfer from gases to boiler walls is a very complicated subject, and space does not permit full discussion of the factors involved. It is enough to point out that the presence of refractories or radiants does not necessarily change the operating efficiency, and is just as likely to lower it as to raise it because it must not be forgotten that the radiant or refractory becomes hot by the selfsame processes of conduction, convection and radiation which in the absence of any refractory would be functioning to transfer the heat directly to the boiler. There is some reason to suspect that a radiant on which an atmospheric gas flame is actually playing may require a larger proportion of secondary air than if the flame were burning free from the radiant. Excess air represents a direct loss. Figs. 1 and 2 on pages 78 and 79 of HEATING AND VENTILATING for March, 1930, show the effect of over-ventilation.

3. Burners with Air Blowers.

Some automatic gas burners are equipped with air blowers. This group forms the most expensive class of burners, but at the same time the

indications are that it yields the best combustion results at the highest efficiencies. In the case of small homes first cost is a serious matter and there may be some question whether it is desirable to make the house-heating equipment dependent upon the availability of electric current.

This brief classification of conversion systems does not imply that the burners fall strictly into these classes, because any one burner may incorporate features of the other types. However, in addition to the burners, every automatic gas system should include the same accessories which a gas-designed boiler will have. This means that there must be a safety pilot, a gas pressure regulator, the necessary pressure and temperature control valves, a room temperature thermostat, a hand controlled valve for shutting off the system, a backdraft diverter in the flue, possibly a low water cutoff for steam boilers, etc. The customer cannot be given proper automatic gas-heating service without all of these controls being present.

Automatic Gas Heat Requires Certain Controls

At the present time the American Gas Association is preparing a recommended practice for the installation of automatic gas burners in existing coal heating plants. This will probably be ready late in 1930. It will cover the details of such equipment, and how to make the necessary measurements to ensure proper service.

The first step in making the installation of an automatic gas burner is to select the proper size burner, assuming that the make of burner has already been selected by the contractor as being one which is suitable for the territory in question. That is to say, it should be a burner which meets with the approval of the local utility for the best and most harmonious relations.

The size of the boiler can be measured in terms of firebox diameter, and an automatic gas burner selected which is designed to fit in that size firebox. Such a sizing method is entirely empirical, and cannot be expected to yield first class results except by accident. A better way would be to find the name and model number of the boiler, and determine the actual rating of that boiler. After having found the rating of the boiler, the gas burner should be installed with a capacity at least equal to the actual output of the coal boiler.

Example: Suppose that a coal boiler was found to have an actual rating of 600 sq. ft. of steam. This would mean that its output amounted to

$600 \times 240 = 144{,}000$ B.T.U. per hr.

A gas burner at 70% efficiency should be selected, having an input of 212,000 B.T.U. per hr., approximately equivalent to 212 cu. ft. of natural gas, or 400 cu. ft. of manufactured gas per hour.

To check this estimate, the radiation of the house should be checked in accordance with the method suggested by the Heating and Piping Contractors National Association or the A.S.H.V.E. *Guide*. This will give an answer in B.T.U. per hour which should come out to about two-thirds of the boiler size, which for this example would be 100,000 B.T.U. per hr. That means that the boiler will have a capacity of about 50% more than the heat loss of the house. This provides adequately for the heat loss from risers and returns, as well as a suitable excess for quick starting under thermostatic control.

Buildings with more than 500 sq. ft. of radiation require less excess capacity than the amounts just indicated. Burner capacities for larger buildings can be estimated on the same basis as suggested for the sizing of gas-designed boilers as given in Table I.

In any case, these calculations will be in terms of B.T.U. per hour of burner capacity for which a suitable orifice or orifices must be selected. The heating contractor is urged to pay very close attention to this point for on it depends the ultimate satisfaction of the owner. The burner must be capable of heating the house comfortably on the coldest day and the only way in which it can be done is to be certain that there will be adequate gas burning capacity available. Of course, the boiler heat absorbing surface must also be sufficient, but the fact that the boiler has presumably been operating satisfactorily already is proof of its adequacy.

Sizing of Gas Orifices

Reference should be made to Table 2, page 80, in HEATING AND VENTILATING for March, so as to be sure that the gas pipe supplying the boiler is of the right size. Then, with the burner controls, it is important that the pressure drop through these be kept at a minimum. In the case of equipment carrying the A.G.A. seal of approval the combined pressure drop through all the controls must be less than 1 in. of water column, but

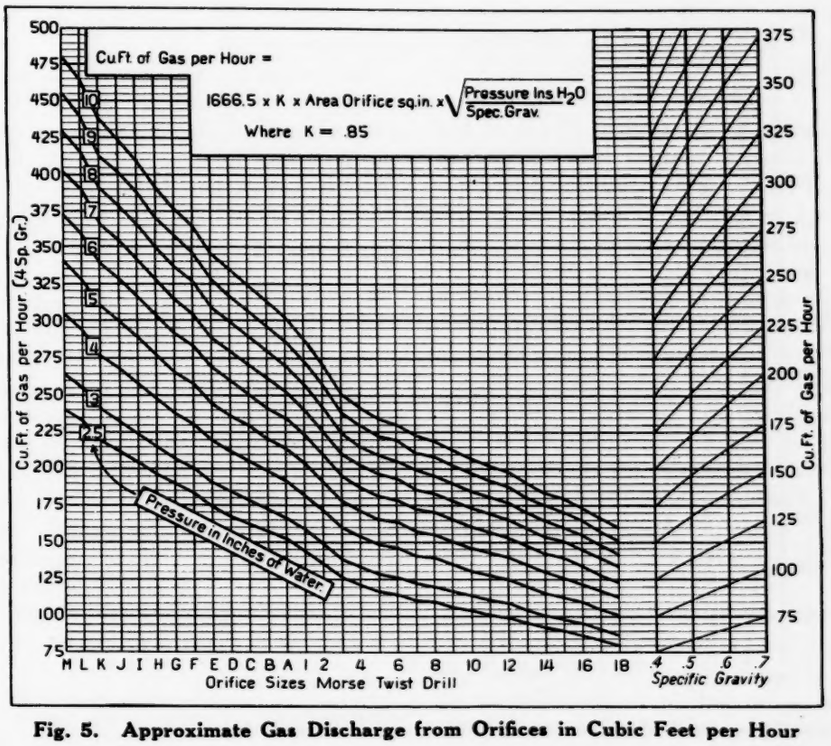
Cu Ft of Gas per Hour =
1666.5 x K x Area Orifice sq.in. x √(Pressure Ins H2O / Spec. Grav.)
Where K = .85
Cu Ft. of Gas per Hour (4 Sp. Gr.)
Cu Ft. of Gas per Hour
Pressure in Inches of Water
Orifice Sizes Morse Twist Drill
Specific Gravity

Fig. 5. Approximate Gas Discharge from Orifices in Cubic Feet per Hour

for conversion burners the amount of this drop is taken care of by the manufacturer and contractor. Proper installation requires that the pressure drop be kept as low as for approved gas boilers. It is suggested that careful study be made of the sizes of the various control valves used with conversion burners so that the owner may be assured good burner operation.

Some actual figures giving the average pressure drops through various valves and controls when operating at given gas capacities will be presented in the next article of this series.

Pressure Loss Must Be Kept at Minimum

Sizing of the gas orifices is the next item deserving careful attention. First, it is important to understand why a maximum of available gas pressure should be maintained all the way to the gas orifice. The best burner conditions result from a high air-gas ratio for a given burner. To obtain these conditions there is required the highest possible momentum in the stream of gas issuing from the orifice. This depends on the available pressure (once the design of the parts has been fixed), and to keep the pressure at the highest practical level the loss of head by friction in the valves, regulators, and other controls as well as through the orifice itself, must be kept down to low values.

Second, the shape of the orifice should be such that it has a high discharge coefficient. This really states the first requirement in different terms, but it leads to a direct consideration of how to accomplish the desired end. The orifice should be drilled from within so that the burr may be filed off. The approach to the actual orifice should be as gentle as it is possible to drill it. The drilling must be centered within the spud or else noisy operation and loss of air injection may result.

The sizing of the drill opening may be read from Fig. 1 as indicated in the following example;

Example: it is desired to find the drill size to use in an automatic gas burner for conversion of a coal boiler installed in a house having a total installed radiation amounting to 420 sq. ft. of steam. The gas has a specific gravity of 0.55, contains 530 B.T.U. per cu. ft. and is served at 3 in. pressure.*

420 sq. ft. of steam radiation = 420 x 240 = 101,000 B.T.U. per hr. loss from the building.

According to the table of selection factors, the boiler should have 56% more capacity, which means the boiler output should be 157,000 B.T.U. Since the average efficiency for an automatic gas burner for converting coal boilers may be taken at 70%, the input to the boiler should be 224,300 B.T.U. per hr. Dividing this by 530, we get 415 cu. ft. of gas per hr.

Supposing that this was divided between two burners. Each one would then have to burn about 200 cu. ft. per hr. Referring now to Fig. 1, on the extreme right hand side we find the number 200 opposite the diagonal line. Follow this downward towards the left until it reaches the mid-point between 0.5 and 0.6 specific gravity. Now follow horizontally to the left until the line marked 3 in. water is intersected. This will be approximately between the lettered Morse twist drill sizes K and J, and the best plan is to select the next larger size, or in other words, the orifice No. K.

Adjustment of gas orifices in the gas burner, as well as the regulation of the pressure regulator, can be done exactly as described previously in this article in connection with the adjustment of gas orifices for warm-air furnaces.

To ensure best operating conditions, a flue gas analysis and a temperature measurement can be made. On the other hand, once a particular type of boiler has been converted, future installations on the same style boiler may be made by merely duplicating the previous work.

The use of a flue gas temperature determination as the criterion of proper adjustment would be all right if the contractor were certain that he had reduced the excess air to the practical minimum value. Considering the natural gas chart on page 78 of the March, 1930, issue, it can be seen how a flue gas temperature of 300° with 11% of CO_2 in the flue gases represents the same operating efficiency as a temperature of 250° with 8% of CO_2 in the flue gases.

*Figures for specific gravity, heat content and pressure can be obtained from the local gas company.

Canadian Use of Insulation Increasing

USE of building insulation in Canada has increased remarkably during the past few years, according to the Department of Commerce, summarized in a statement issued by the department. Where formerly only certain types of buildings and warehouses considered insulation in construction, today increasing attention is being paid to the heat proofing and sound proofing of buildings of all types, according to the statement, which follows:

Because of the cold climate, insulation is a very important item in the construction of Canadian buildings of all kinds. The major producers and importers of this product have been active in bringing the benefits of insulation before the public through advertising, with the result that Canadian consumption of heat proofing materials, especially rigid wall boards, had practically tripled during the past four years. Domestic production has more than kept pace with demand and a slightly higher ratio of increase is noted for that period. In addition to insulation for retaining heat in larger buildings and for excluding warm air from cold storage warehouses, many homes are adapting insulation, not only in the case of new construction, but also for houses already built. In the far north insulation is widely used in mining camps and other isolated outposts for protection against arctic cold.

Although most of the rigid wall boards in Canada are made in the country, other types, such as semi-rigid, blankets, etc., are largely imported from the United States. The development of the Canadian industry along the lines of insulation has been freely encouraged by the Canadian National Research Council through its associate committee on heating and insulation, which has carried out many studies and investigations of various types of insulators through laboratories in large Canadian universities.

The council is constructing a laboratory for heat insulation and acoustical research in connection with their new research building in Ottawa.

Estimating and Designing Heating Systems

X—Properties of Steam

by **FRED W. HANBURGER**

Special Lecturer on Heating and Ventilation, College of the City of New York

IN order to understand the properties of steam it is necessary to understand the laws that apply to gases in general. Nearly all gases follow closely along definite laws which are termed ideal because they are the laws a gas would follow if it were a perfect gas. No gas can be said to be absolutely perfect in following physical laws, but most of them do follow ideal laws so closely that for our engineering calculations we can assume that they are perfect gases.

Steam is possibly the blackest sheep of all and strays so far from the perfect path that these laws cannot apply and we must resort to tables which give steam properties under varying states and conditions, as obtained by test and trial. Nevertheless, to appreciate fully the Steam Tables we should understand the ideal laws.

These laws express the relation between pressure, volume and temperature. The first, known as Boyle's Law or the Law of Mariotte, states that when the temperature of a given weight of gas is kept constant, the pressure varies inversely with the volume. Thus 10 cu. ft. of air with a pressure of 14.7 lbs. per sq. in., if compressed to a space of 5 cu. ft., would need a pressure of 29.4 lbs. per sq. in. Again, if in addition to this 10 cu. ft. of air at 14.7 lbs. per sq. in. pressure, we increase the pressure to 5 times the atmosphere, making the total pressure 73.5 lbs. per sq. in., the volume would be reduced to 1/5 or 2 cu. ft. (if the temperature is kept constant). This can be expressed in formula form thus

$$P_1 \times V_1 = P_2 \times V_2 = P_3 \times V_3. \quad (1)$$

Known as Charles' Law or the Law of Gay Lussac, the second law states that the volume at constant pressure, or the pressure at constant volume, is proportional to its absolute temperature. Thus, if we double the absolute temperature of a gas and keep its pressure constant it will expand to twice its original volume. Again, if the gas were kept confined and not allowed to expand, its pressure would be doubled. This law expressed in formula form would read

$$\frac{P_1 \times V_1}{T_1} = \frac{P_2 \times V_2}{T_2} = \frac{P_3 \times V_3}{T_3}. \quad (2)$$

In both of the equations, the absolute pressure and the absolute temperature must be used. The term pressure as generally used in practical work and as indicated on a pressure gauge is but a relative term and expresses the intensity of the pressure over and above the already existing atmospheric pressure. Thus, a gauge on an empty steam boiler registers zero but there still exists in the boiler the pressure of the atmosphere, so that when steam is generated it must first generate the pressure of one atmosphere before the gauge will begin to register. At this point the absolute pressure is 14.7 lbs. per sq. in., while the gauge pressure is 0 lb. per sq. in. With a gauge pressure of 5 lbs. the absolute pressure is 19.7 lbs. per sq. in.

Temperature, as expressed in the various thermometer scales, is also a relative term and differs according to the scale used. In the Fahrenheit scale the zero point is taken at 32 Fahrenheit degree spaces below the freezing point and in the Centigrade scale the freezing point is more logically taken as zero.

In neither case, in the strict sense of the word, is this a true zero as we know that heat does still exist at these points. In the development of the law as expressed in equation (2) it was found that the contraction and expansion of a perfect gas followed definitely fixed lines. At 0° F., when the temperature was lowered 1°, the contraction was $\frac{1}{460}$ of its volume; at 1° below zero, or —1° F., its construction was $\frac{1}{(460-1)}$ or $\frac{1}{459}$ of its volume; at —10° F. its contraction was $\frac{1}{(460-10)}$ or $\frac{1}{450}$ of its volume. Following this same reasoning through, at 458° F. below zero, or —458° F., its contraction should be $\frac{1}{(460-458)}$ or $\frac{1}{2}$ of its volume, and on lowering its temperature 1° further, from —459° to —460° F. its contraction should be $\frac{1}{(460-459)}$ or $\frac{1}{1}$, or all of its volume.

Taking the air surrounding our earth as an example, at 460° the air will have contracted in volume so that it would be unnoticed on the point of a needle. Unfortunately, or should we say fortunately, gases do not obey the law at very low temperatures—they turn to liquid or solid form before this point is reached. This theoretical point, 460° F. spaces below the zero (the precise figure is —459.6°), is taken as the point of absolute zero and all Fahrenheit readings must be increased by 460° to reduce them to the absolute scale.

In equation (2) it will be noticed that the relation is always constant, so that if we know the weight of a gas at some fixed temperature and pressure the constant can be determined for that gas. Thus knowing the weight of air at 70° F. and at atmospheric pressure to be 0.075 lbs. per cu. ft. and taking a volume of 1 lb. of air, we can substitute these values in the equation to obtain the constant for air. The temperature of 70° F. must first be expressed in absolute temperature and is (460° + 70°) or 530°, and the pressure must be expressed in pounds per square foot which will be 14.7 lbs. per sq. in. × 144 sq. in. = 2116.8 lbs. pressure per sq. ft. Substituting these values in equation (2) and reducing, we have PV = 53.3 T, where 53.3 represents the constant for air. This is usually written PV = RT, where R represents the constant for the gas in question.

While it can be shown that the constant R represents the amount of external work done when the gas is raised 1° at constant pressure, the following analysis may give the student an idea of the value of R that will aid him in his heating and ventilating problems.

Let us assume that the layer of air surrounding the earth to have the same density throughout the height of its column. At a temperature of 70° F., or 530° absolute, and the pressure 2116.8 lbs. per sq. ft., the weight of a cubic foot of air is 0.075 lbs. The height of the column to produce this pressure must be

$$\frac{2116.8 \text{ lbs.}}{0.075 \text{ lbs. per ft.}} = 28224 \text{ ft.}$$

Were it to obey the law of gases throughout the entire temperature range, this column would contract to $\frac{1}{530}$ of its height or $\frac{28224 \text{ ft.}}{530} =$ 53.3 ft. if the temperature were reduced to 1° absolute, and still assuming that it has the same density throughout its height. At this temperature by merely going to an upstairs window we could attain atmospheric heights that no aviator could ever hope to reach. Carrying this thought a little further, this air column of 53.3 ft. (53.3 is R for air) still creates a pressure at its base of 2116.8 lbs. per sq. ft. and the weight of a cubic foot would then be

$$\frac{2116.8 \text{ lbs.}}{53.3 \text{ ft.}} = 39.69$$

which is a constant for air and can be looked upon as the weight of 1 cu. ft. of air at a temperature of 1° absolute had it followed the law of gases throughout. We can now determine the weight of a cubic foot of air at any temperature by dividing 39.69 by its absolute temperature. Thus at 32° F. its weight is $\frac{39.69}{492} = 0.0807$ lbs. At 0° F. it is $\frac{39.69}{460} = 0.0864$ lbs., etc.

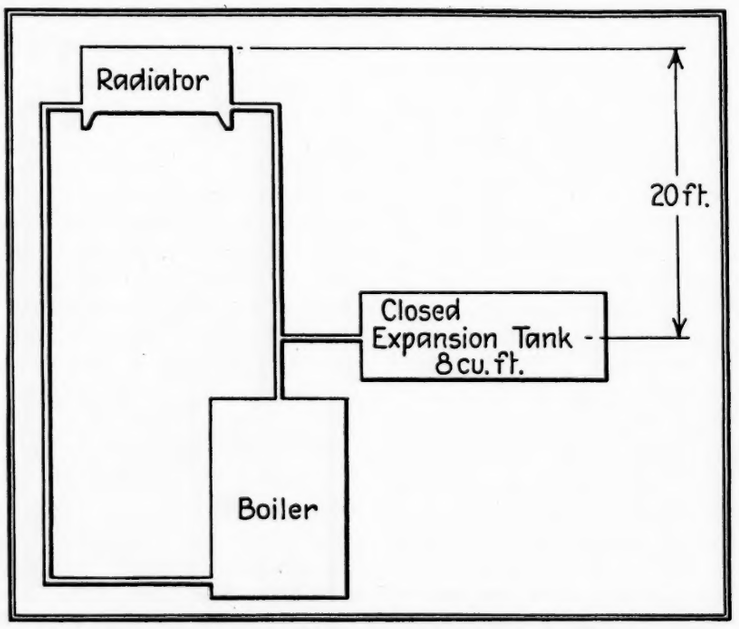

Fig. 28. Diagram Used in Volume and Pressure Change

A practical application of equations (1) and (2) may be had in the case of a closed expansion tank on a hot water heating system as shown in Fig. 28. Let the tank have a capacity of 8 cu. ft. and the height of the system be 20 ft. above the centre of the tank. With the system empty the air in the tank will have $P_1 =$ 14.7 lbs. per sq. in. and $V_1 = 8$ cu. ft. When the system is filled some water will enter the tank and compress the air. This added pressure will be

20 ft. × 0.434 lbs. = 8.68 lbs. per sq. in., so that P_2 will then be (14.7 + 8.68) = 23.4 lbs. per sq. in. Substituting in equation (1) we then have 14.7 lbs. × 8 cu. ft. = 23.4 lbs. × V_2, whence V_2 is found to be 5 cu. ft. and therefore 3 cu. ft. of water must have entered the tank.

When the water in the system is heated, more water will enter the tank, due to expansion. Assuming the water volume in the system is such that this expansion is 1 1/2 cu. ft., the air volume under this third condition becomes 5 — 1 1/2 = 3 1/2 cu. ft. This can be taken as V_3, and P_3 can then be found from the equation

14.7 lbs. × 8 cu. ft. = P_3 × 3 1/2 cu. ft., whence P_3 is found to be 33.6 lbs. per sq. in. absolute.

These relations are only true as long as the temperature is kept constant. The air in the tank, however, has become heated both by compression and from the heat in the system. If the temperature originally was 60° F. and under the last condition was found to be 140° F., the pressure can be determined by equation (2). Under this fourth condition the volume remains unchanged and V_3 becomes V_4, $T_3 = 520°$ absolute and $T_4 = 600°$ absolute. Substituting these values in equation (2) the final pressure is found to be 38.8 lbs. per sq. in., an increase of about 15 lbs. per sq. in. above that of the cold system.

It is generally at this increase of pressure that the relief valve is supposed to operate. The student can see that if this air space had been less than 5 cu. ft. after the system had been filled with cold water, the heating system could never be brought to a proper heating temperature before the relief valve would discharge.

Application of Air Conditioning to Premature Nurseries in Hospitals

by **C. P. YAGLOU, PHILIP DRINKER and K. D. BLACKFAN**

RESULTS from a four-year study of the influence of air conditions on the growth and development of premature infants at the Infants' Hospital in Boston show that a mechanical air-conditioning system of the central station type can be applied with marked success to the group care of these infants. Air-conditioning requirements for the premature nurseries at the Infants' Hospital were found to be a ventilation rate of 25 air changes per hr., an air movement of 15 ft. a min. over the beds, a relative humidity of from 50% to 65%, and environmental temperatures varying approximately from 100° to 76° F., depending on the general condition of the infant and its body weight.

In order to meet these requirements, two conditioned nurseries were necessary, one about twice as large as the other. The special needs of congenitally-diseased infants, particularly those of the 1.5 to 2.0 lb. groups, were taken care of most satisfactorily by the use of open top electric incubators or heated beds placed inside the larger nursery.

The system should be designed for maximum indoor temperatures of 80° and 90° F. in the larger and smaller nurseries, respectively, and for a dew-point of 70° F. in winter and 60° F. in summer. No recirculation allowance should be made in estimating the capacity of such systems. The problem of temperature control deserves especial attention, because premature infants are peculiarly sensitive to temperature changes.

Application of air conditioning to the premature nurseries was followed by a marked reduction in the incidence of diarrhea and in the mortality rate. Infections were reduced to a minimum and gains in body weight increased. These benefits are attributed to advances in medical treatment and improvement in nursing and general care, as well as to the installation of the air conditioning system described in the following text.

A premature infant is taken to mean any infant born between the sixth and ninth months of foetal age. These infants are small, weighing between 1½ and 5½ lbs. and the majority of them require special treatment if they are to survive. In the same category, so far as hospital care is concerned, are the congenitally-diseased and other debilitated infants.

The condition of first importance in the care of such infants is the conservation of body heat and energy, for their vital organs are not completely developed. The metabolism, or internal heat production, is low compared with that of full term, normal infants; moreover, the heat loss is greater than that of normal infants on account of wrinkled skin surfaces and absence of fat deposits in the skin. In short, premature infants generally exhibit marked inability to maintain a normal body temperature by their own efforts and they show little resistance to infections, especially respiratory infections. The mortality rate exceeds 50% and has two peaks, one occurring in cold weather and the other in excessively warm and humid weather.

Success in the treatment of premature infants depends mainly on four factors: (*a*) stabilization of body temperature, (*b*) proper nutrition, (*c*) nursing care, and (*d*) prophylaxis against infection.

The usual methods employed for controlling the body temperature of premature infants are the use of heated beds, electric pads, and electric incubators and the application of plenum systems of heating and ventilation. Although the importance of air temperature has been generally appreciated, the direct effects of humidity and rate of air change upon body temperature, with their indirect effects on nutrition, growth, infection, and the like, have not been fully understood.

In the air-conditioned nurseries of the Infants' Hospital, a ventilation rate of 25 air changes per hr. was required to keep the room atmosphere free of odors and to maintain the desired temperature and humidity conditions. An air movement of about 15 ft. a min. over the beds, as measured by the kata-thermometer, proved satisfactory.

It is perhaps unnecessary to point out that neither the comfort zone nor the effective temperature index determined for adults at the Research Laboratory of the society holds for these infants, who differ so much from normal adults in their metabolic and circulatory functions and in the development of their sweat glands.

The preliminary survey showed that the temperature requirements of premature infants vary widely according to their general condition and their body weight. The amount of clothing worn and the humidity of the air also are of importance. Accordingly the infants were classified into two main groups: (*a*) the normal premature and (*b*) the congenitally diseased infants. Each main group was divided into sub-groups according to body weight, as shown in Table 1.

From observations on body temperature, gain in weight, incidence of diarrhea, mortality, and general behavior of the infants under various humidity conditions, a relative

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TABLE 1—AIR CONDITIONING REQUIREMENTS OF PREMATURE INFANTS AT INFANTS' HOSPITAL (BOSTON), 1926-1929

Weight Groups Lb.	Normal Premature Infants			Congenitally Diseased Infants		
	Room Temperatures, F. (Dew-Point, 64 F; Air Movement, 15 ft. a minute)			Incubator Temperatures, F. (Relative Humidity of Room, 65%; Air Movement, 15 ft. a minute)		
	Minimum	Maximum	Average	Minimum	Maximum	Average
1.5–1.9.....	83	88	86.0	86	100	93.5
2.0–2.4.....	82	87	84.5	86	98	90.5
2.5–2.9.....	78	86	83.0	84	95	88.0
3.0–3.4.....	77	86	80.5	79	90	83.5
3.5–3.9.....	75	85	78.5	79	88	81.0
4.0–4.4.....	75	85	77.0	78	86	79.0
4.5–4.9.....	75	85	76.0	76	85	77.0
5.0 and over.....	..	80	....	..	85	....

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humidity of 65% was adopted. When humidities as low as 30% (a considerably higher value than that prevailing in unconditioned nurseries during cold weather) were maintained for two weeks or longer, the body temperature became unstable, gains in weight diminished, the incidence of diarrhea increased, and mortality rose. Continuous exposure to air conditions with 55% to 65% relative humidity, on the other hand, gave very satisfactory results over a two-year period (1928 and 1929). It is of interest to notice that the relative humidity of 65% which was adopted as the optimum for prematures is in close agreement with the humidity conditions recommended by Huntington* for adults of the white race.

Table 2 shows how a single central apparatus, furnishing conditioned air at 64° F. dew-point to two nurseries, was made to meet the requirements of all the infants. Normal prematures weighing 1.5 to 3.5 lbs. were cared for in the smaller nursery in an atmosphere of 80° to 85° F. and a relative humidity of 50% to 59%. The larger group of normal prematures—those weighing from 3 to 4.5 lbs. occupied the larger nursery where the temperature was 77° F. and the relative humidity 65%. The special requirements of certain infants within each group were met by the use of hot water bottles and by varying the amount of clothing worn. As soon as the infants reached the weight of 5 lbs. they were removed to the wards.

Since the number of congenitally-diseased infants to be treated at any one time is small, they can be cared for in individual electric incubators, placed inside the larger nursery with tops open, and the heat adjusted according to requirements. Temperatures as high as 100° F. are sometimes temporarily employed. In this way, the infants breathe the comparatively cool room air at about 65% relative humidity and the attending doctors and nurses are not subjected to extreme temperature conditions.

*Huntington, Ellsworth: Civilization and Climate. Yale University Press, 1924.

The Air-Conditioned Nurseries at the Infants' Hospital

General Specifications and Recommendations for Future Installations: The nurseries consist of two adjoining rooms 12 ft. x 8 ft. x 12 ft. and 12 ft. x 12 ft. x 12 ft., the last dimension being the height. Both rooms are equipped with double windows. At the time the air-conditioning system was installed, the larger room was partitioned into cubicles and the partitions were allowed to stand, since they did not interfere with ventilation.

The system was originally designed for 45 air changes per hr. in each room, with provision for reducing the air changes to 20 per hr. by means of variable speed fan-motors. Later it was found that the actual requirements were only 25 changes per hr., so that it was possible to add a third room to the system, thus making use of the full capacity of the air-conditioning apparatus. This new room, measuring 11 ft. x 20 ft. x 9 ft. is used as a special observation nursery for full term infants suffering from such ailments as fever, diarrhea, and other gastro-intestinal disturbances.

TABLE 2
AIR CONDITIONING SCHEDULE ADOPTED FOR PREMATURE NURSERIES OF INFANTS' HOSPITAL (BOSTON)

Classification of Infants	Weight Groups Lb.	Temperature F	Relative Humidity Per Cent	Air Movement Ft. Per Min.	Method of Treatment
Congenitally diseased and malformed infants	1.5–5.0	(86–100)*	†	15	Infants placed in open top incubators inside large nursery and heat gradually adjusted according to requirements.
Normal prematures	1.5–3.4	80–85	59–50	15	Infants placed in small room and room temperature adjusted according to requirements. Hot water bottles (110 F) used in special cases.
	3.5–4.9	77	65	15	Infants placed in large nursery. Hot water bottles (100 F) used sparingly in special cases.
	5.0 and over	70–74	Ward	Ward	With exception of definite cases of hypothermia, infants are removed to wards.

* Incubator temperatures taken between basket and metal wall.
† Infants breathe cool room air at about 65% relative humidity.

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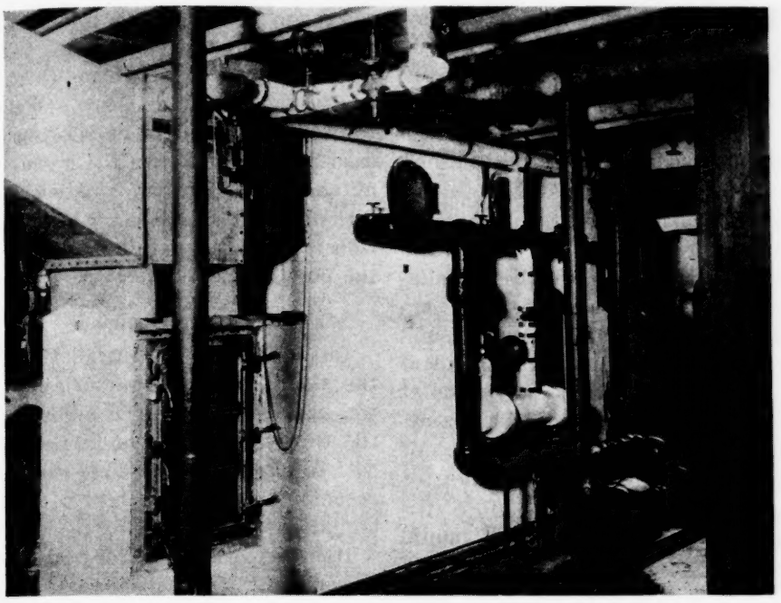

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Fig. 1. Central Air-Conditioning Apparatus

Apparatus has sufficient capacity to maintain the three rooms at a maximum temperature of 110° F. with a maximum dew point of 80° F., when all the air is taken from out of doors at 0° F. In summer, the rooms can be cooled to 75° F. and the dew-point lowered to 60° F. when the outdoor dry-bulb does not exceed 95° F. and the wet-bulb 75° F.

By referring to Table 2, it can be seen that the maximum winter conditions for which the apparatus has been designed are needlessly high, and that it would be adequate to design such systems in the future for temperatures of 90° F. and 80° F. in the smaller and larger rooms, respectively, and for a dew point of 70° F. The refrigeration capacity of the equipment happens to be quite close to the actual requirements, as shown in Table 2. No recirculation allowance should be made in the design of such systems.

Description of Apparatus

The supply system consists of the following:

(*a*) Outdoor air intake, containing a weatherproof hood and a screen.

(*b*) Light weight copper tempering coil, controlled thermostatically.

(*c*) A dehumidifier of the horizontal mist spray type for humidifying the air in winter and for cooling and dehumidifying the air in summer. Humidification in winter is accomplished by means of a closed-type water heater which warms the spray water. In summer the spray water is cooled in a Baudelot cooler, on top of which the dehumidifier is mounted. A centrifugal pump circulates the spray water.

(*d*) A supply fan, which draws the air through the dehumidifier and forces it through the rooms.

(*e*) Individual light-weight copper reheaters, controlled thermostatically, for warming the air to the temperature desired at the room inlet registers.

(*f*) Individual supply ducts, fitted with dampers and registers, near the ceiling of the rooms for even distribution of the air inside the rooms.

The exhaust system consists of the following:

(*a*) Individual exhaust ducts, fitted with dampers and registers, near the floor of the rooms for withdrawing the used air from the rooms.

(*b*) Exhaust fan to which the individual exhaust ducts from the rooms are piped.

(*c*) Recirculating ducts for recirculating part of the air at the inlet side of the dehumidifier.

(*d*) Main exhaust outlet duct which discharges the used air out of doors.

System of Duct Work: The supply ducts extend across the entire length of the rooms on an interior wall, at a height of 8.5 ft. from the floor. Air distribution is secured by means of adjustable louvre registers, spaced along the face of the ducts about 2 ft. on centers. The conditioned air is blown across the rooms directly against the exposed walls and glass, which constitute the cooling surfaces in winter and the warming surfaces in summer.

After circulating across the rooms, the air is withdrawn near the floor by means of exhaust ducts, which are similar in all respects to the supply ducts. Figs. 2 and 3 show the general arrangement of the supply and exhaust duct system in the two premature nurseries. They also show the cubicles, beds, supply closet, etc.

Some difficulty was experienced in distributing the air uniformly inside the rooms so as to secure an air movement of about 15 ft. a min., as measured by the kata-thermometer, in the zone occupied by the infants. This was finally accomplished by reducing the air changes from 45 to 25 an hr. and by adjusting the louvres of the registers so as to deflect the air toward the ceiling and thence against the windows.

Reduction in the number of air changes from 45 to 25 an hr. has, in addition, considerably diminished the air noise in the ducts. According to the authors' experience, both supply and exhaust risers for such systems should be designed for air velocities of 450 ft. per min. or less, according to the size of the ducts.

Humidity Control: Control of humidity by the wet-bulb temperature method was unsatisfactory for this particular installation, because the wet-bulb temperature in the rooms varied as much as 6° F. and the system was loaded with many automatic devices, which required constant attention.

By rearranging the regulators and valves and by eliminating superfluous pieces of apparatus, the authors were able to use a central dew-point control, which proved much superior to the former system. In this modified system, the dew-point regulator is placed in the path of the air leaving the dehumidifier. In winter the regulator controls the supply of steam to the water heater by means of compressed air and thus warms the spray water as desired. In summer the regulator controls a three-way valve on the suction side of the water pump. One side of this valve connects to the pump itself, another side to the refrigerated water in the

Baudelot cooler tank, and the third side to the warm water in the dehumidifier tank. The desired dew-point is maintained automatically by mixing the right proportion of cold water from the cooler tank with warm water from the dehumidifier tank.

Operation of Apparatus

In winter the incoming air is warmed automatically by the preheater to about 65° F. In passing through the spray chamber, the air absorbs a sufficient amount of moisture to saturate it at a temperature somewhat higher than the dew-point of 64° F. at which the rooms are kept. The difference between the dew-point at the apparatus and that in the rooms represents the loss of moisture by absorption and diffusion through the walls of the rooms. In order to compensate for this loss, the dew-point of the air leaving the dehumidifier is increased systematically 1° F. each month beginning in October, until it reaches a maximum value of 68° F. in January, the coldest month in Boston. Beginning in February, the dew-point is gradually reduced 1° F. each month until May, when it is brought back to 64° F. From May to October, the dew-point in the rooms is practically the same as that at the apparatus, except during short periods of extreme weather.

During the heating season, the reheaters warm the air to whatever temperature is demanded by the room thermostats. Since no direct radiation is used in the rooms, the ventilating current must furnish sufficient heat to balance all the heat losses and to maintain the rooms at the desired temperature. This is accomplished with a maximum drop of about 10° F. in the temperature of the ventilating current.

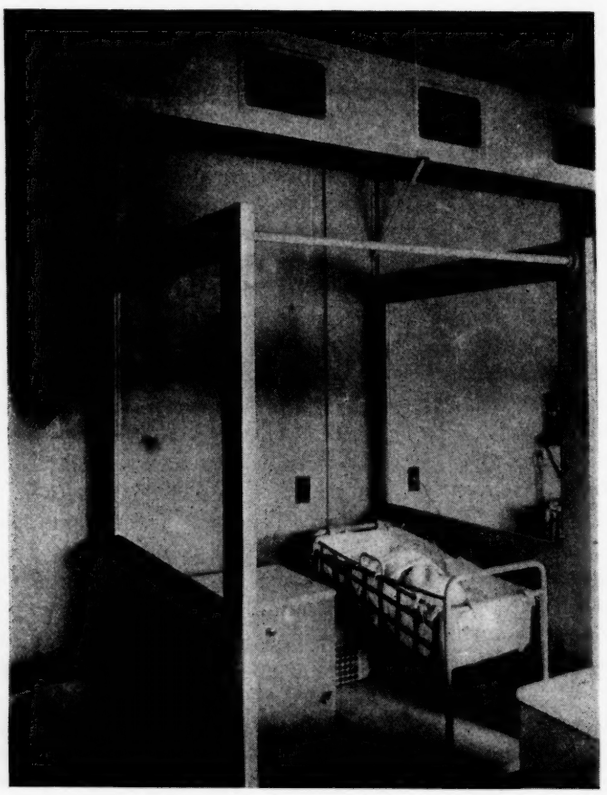
In summer the warm and humid air from out of doors is cooled and dehumidified to 64° F. by contact with the cold water spray. In passing through the fan and duct work, the air increases in temperature from 2° to 7° F., depending upon the location of the room and upon the weather conditions. In circulating through the rooms, the air absorbs sufficient heat from the warm walls, glass, lights, and bodies of occupants to raise its temperature and at the same time decrease the relative humidity to the desired degree. If the heat leakage into the rooms through the walls and glass is not sufficient to produce this effect, as is often the case in cool weather, the reheaters automatically furnish whatever additional heat is needed. Recirculation is used sparingly on account of the possibility of infection.

Cost Data

Initial cost of the installation for the two premature nurseries alone was about $5,700. The addition of the third nursery brought the total cost to about $7,000. This sum represents the minimum cost of an installation of this type.

Itemized yearly cost for continuous operation at full capacity is:

Electric power ($15 per year per kw. of demand and $0.015 per kw-hr. of consumption)	$370
Steam ($0.10 per million B.T.U. of demand and $0.60 per million B.T.U. of heat)	670
Refrigeration ($1.25 per ton)	300
Water and compressed air	60
Supervision	300
Repairs and maintenance	150
Yearly operating cost (exclusive of depreciation and interest on capital investment)	$1,850



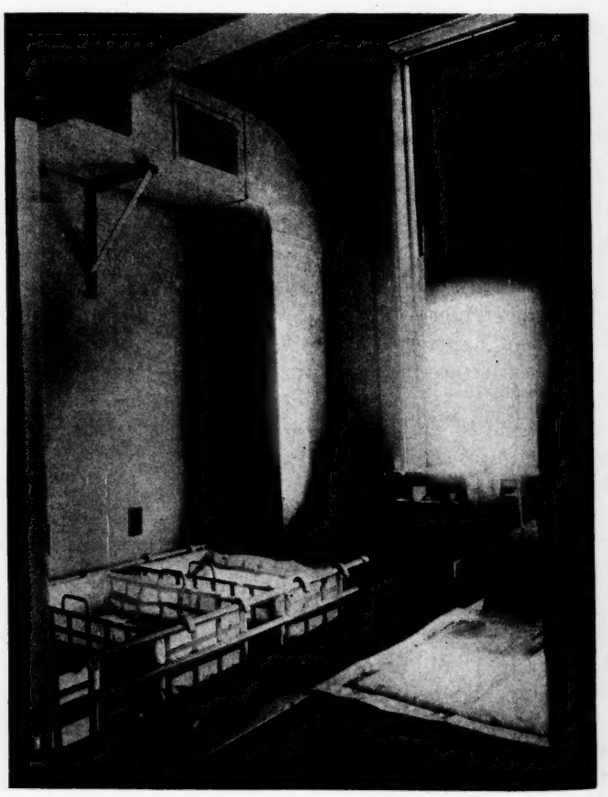


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Fig. 2. Supply and Exhaust Ducts in Larger Premature Nursery

Fig. 3. Supply Duct in Smaller Premature Nursery

Trends in American Engineering Practice

1—Unit Heaters and Fan Duct Systems

IN an effort to learn the trend of prevailing practice in different sections of the country with regard to certain features of engineering work, HEATING AND VENTILATING has just completed a survey covering such subjects as unit heaters and fan duct systems, cast-iron and steel boilers, oil burners, gas boilers, domestic stokers, steam and hot water heating, air conditioning, building insulation, light-weight concealed radiation, unit ventilators and zone heating.

The results of the survey will be published in serial form, each subject being presented separately. Replies are given just as they were received and are in no way to be interpreted as the conclusions of HEATING AND VENTILATING.

By segregating the replies it has been possible to reflect prevailing practice in each section of the country.

Northeastern

Portland, Me. "It is safe to say that unit heaters have practically superseded fan duct systems, except in some types of buildings where it is necessary to ventilate the basements, in which case a small fan will be installed to take care of this part of the building. Exhaust systems sometimes are designed as gravity systems and at other times with fans. This applies to school houses and similar buildings. Hotels and theatres still have central fan systems."

Presque Isle, Me. "Have used unit heaters exclusively since 1922."

Portland, Me. "Our present practice is approximately 80% unit heaters, the balance fan duct systems."

Fitchburg, Mass. "Floor-type unit heaters are satisfactory where drafts do not matter; where high velocities of air do not bother the employees; where dust is not a factor and where there are no benches or other obstructions to stop or prevent circulation of the air. Ceiling-type unit heaters we do not use except when the owner demands them. We see nothing in their favor except a saving of floor space. Fans and duct systems are preferable for ventilation in buildings such as schools, hospitals, etc., where a large amount of ventilation is required and where a central system is preferable to a number of isolated units."

Boston, Mass. "Unit heaters are being used quite extensively, more so than fan duct systems."

Boston, Mass. "Except in very special instances we use unit heaters, instead of fan duct systems."

Boston, Mass. "We consider unit heaters primarily a device for industrial heating application. As such, unit heaters have practically displaced duct systems."

Westfield, Mass. "We install unit ventilation almost exclusively."

Boston, Mass. "We would adopt whichever meets the particular conditions to best advantage. Unit heaters are good where practicable."

Providence, R. I. "We use many unit heaters, but do not now install any fan duct systems."

North Atlantic

Hempstead, L. I. "We prefer unit heaters to fan duct systems because they take up less space in the building and are less troublesome to design and install. We have found that we get much closer control both of air delivery and temperatures. The chief problem to be worked out with unit heaters is humidification."

New York, N. Y. "The choice depends on building conditions. I have used both fan duct systems and unit heaters."

Buffalo, N. Y. "We prefer unit heaters to fan duct systems in most instances."

Jamestown, N. Y. "We prefer unit heaters. Use very little fan work."

New York, N. Y. "We prefer fan duct systems in schools, public buildings, office buildings and wherever air conditioning is a requisite. Unit heaters in garages, small industrial buildings, subdivisions of large industrial buildings; sometimes for heating large vestibules where space conditions prohibit other forms of heating service."

New York, N. Y. "In buildings such as public schools, or other similar types, where many unit heaters would be required, we prefer the use of one or more central fan systems for ventilating purposes."

Jersey City, N. J. "We prefer unit heaters to fan duct systems."

Oaklyn, N. J. "Unit heaters are fast gaining the ascendancy over fan duct systems, because they are more flexible and cheaper to install. However, we cannot discard the central fan altogether, particularly in large office buildings, some schools and certain kinds of factory jobs."

Newark, N. J. "The fan duct system of ventilation when properly designed, installed and operated, can be relied upon to produce more complete, more economical, more easily controlled and better air conditioning than can be produced with unit heaters or ventilating units throughout a great many classes of buildings. This refers particularly to schools, public buildings, institutional buildings, hotels, theatres and office buildings."

Pittsburgh, Pa. "We prefer unit heaters almost entirely."

Philadelphia, Pa. "I prefer a fan duct system to unit heaters. I feel that you can get better distribution and control with a fan duct system."

Philadelphia, Pa. "We use both fan and duct systems and unit heaters. The use of unit heaters, we find, is increasing rapidly, and most of the schools we have been planning recently provide for unit heaters. In Pennsylvania, the Department of Education has a ruling which permits direct radiation to be used to warm to 55° only. This mitigates against the use of the central air supply system in our practice very considerably."

Pittsburgh, Pa. "We prefer unit heaters in all types of buildings and find that they are replacing fan duct systems very quickly, because they are more economical to operate and more satisfactory results are obtained."

Richmond, Va. "It all depends on the character of the building. There are some buildings in which the fan duct system would be foolish and vice versa with unit heaters. They both have their mission to fill."

Philadelphia, Pa. "We do not use either the fan duct or unit heater system exclusively, but select the one best suited for the job in mind. We have used both of these systems."

Middle

Fort Wayne, Ind. "In this locality unit heaters, recirculating type, are fast replacing fan duct systems in industrial

plants. For school buildings it cannot be said that either system is used extensively. This territory leans toward the so-called direct-indirect system of heating and ventilating in schools, with radiators placed under the windows, duct connections through the radiation from the exterior, and ventilating flues augmented by aspirating radiators. In certain portions of such buildings, such as gymnasiums and auditoriums, unit ventilators may be found. There are comparatively few installations of the central fan system."

Chicago, Ill. "We use both, as conditions require."

Chicago, Ill. "We use fan duct systems in preference to unit heaters, as they are less conspicuous and less noisy."

Detroit, Mich. "In school work we probably design two buildings with unit heaters to one building with fan duct systems."

Detroit, Mich. "Fan duct systems still predominate. However, unit heater design is improving and the field is broadening for application, supplanting fan duct systems in some cases."

Minneapolis, Minn. "We do not have any fixed scheme of operation, but rather endeavor to analyze the situation and put in the equipment which we feel will be best suited to the requirements."

St. Paul, Minn. "Our practice is about equally divided between duct systems and unit ventilating for ventilation work. For heating, unit heaters are used in 95% of designs made."

Kansas City, Mo. "Fan duct systems are used more generally than unit heaters because of the opportunity for air conditioning."

Kansas City, Mo. "Split systems of heating using fan and coils for ventilating of direct radiation in the rooms are more generally used than any other system for ventilation of school buildings. Unit heaters are being used to a great extent, but more especially in private buildings."

Kansas City, Mo., "Most people use either a fan duct system or a unit heater system, according to which they happen to be accustomed to or manufacture or represent. In our work we do not aim to do that, hence have gotten into the manufacture of both lines. We use the fan duct system with the fan located at some remote point where quietness is desired. It puts the fan farther away from the point where noise would be objectionable, enables us to use bigger apparatus and put on a silent V-drive, run the fan slower, using a larger fan to get the volume. This is our practice in churches, schools and many other buildings. We use unit heaters in factory buildings that are divided up into different rooms and where the ducts of a fan system would make such a system more expensive than the unit heaters. This, of course, only applies where noise is not objectionable.

St. Louis, Mo. "We do not believe that fan duct systems can be considered in the same class with unit heaters. For positive air conditioning, we believe the fan duct system to be superior. In their own sphere unit heaters have a definite place."

Southwestern

Fort Worth, Tex. "Our experience has been with fan duct systems for conditioning in department stores, and unit heaters for larger rooms, such as ballrooms and roof gardens in hotels."

Chattanooga, Tenn. "In large areas where there are no obstacles or operations carried on to prevent the proper circulation of air at low velocities, unit heaters are preferable; they are cheaper to install and more satisfactory. In ordinary factory buildings, garages, retail stores and similar buildings the air circulation is generally satisfactory with unit heaters. The piling of goods in a warehouse building and the operations in a factory occasionally interfere with air circulation to such an extent that the duct system is advisable. Of course where the area is split up into small rooms, individually too small for unit heaters, the duct system is necessary."

Western

Billings, Mont. "We use fan duct systems for schools and churches but we have used unit heaters for garages and warehouses."

Oakland, Cal. "We use fan duct systems and unit heaters in different types of buildings, depending on how much money can be spent for the work and the suitability of the equipment for the particular building in which it is used."

Sacramento, Cal. "The fan duct system is still given preference over the unit heaters for any major installation. Unit heaters have been used in smaller types of school auditoriums, church auditoriums and the like."

Seattle, Wash. "We always use fan duct systems wherever possible, due to the fact that we can use air washers and other air conditioning apparatus or, at least, provide for the future installation thereof."

Time Payment Finance Company for Canada

Announcement has been made of the organization in Canada of the Heating and Plumbing Finance Limited with head office at 1320 Dufferin St., Toronto, Ontario, to finance the products of all Canadian subsidiaries of American Radiator and Standard Sanitary Corporation. These subsidiaries are the Dominion Radiator and Boiler Co., Ltd., and Standard Sanitary Mfg. Co., Ltd. The finance plan will be known as the Dominion Standard Time Payment Plan and is identical in all respects to the plan used in the United States by the parent corporation's other financing subsidiary, the Heating and Plumbing Finance Corporation.

Heating Contractors to Benefit by Special Deferred-Payment Plan

In an effort to assist heating contractors in developing business during the spring and early summer months, the Heating and Plumbing Finance Corporation announces a "Special Summer Plan" whereby heating installations can be made in the spring and summer on the usual down payment of 10% with no further payment required until September. The Heating and Plumbing Finance Corporation of New York and Chicago is the financing subsidiary of the American Radiator and Standard Sanitary Corporation.

By virtue of the "Special Summer Plan," both landlords and home-owners can be assured of high-class installations because contractors have more time in which to make them. Landlords still can defer payment until they increase the rent and thus pay out of increased income, while home-owners can have the use of their money during the intervening months. By having the work done during warm weather, contractors often are enabled to offer inducements to the purchaser, in the way of price saving.

The contractor, under this "Special Summer Plan," can offer his employees steady employment, and, at the same time, pick and choose his men more carefully. As a result, a better class of workmanship is secured, resulting in less servicing and better satisfied customers. This means a considerable saving to the contractor and insures goodwill customer advertising. By thus extending the heating season the plan has the effect of lowering the contractor's overhead cost per job, enabling him to install more jobs per year with greater net profits.

Due to the drop in new construction activity, the plan, it is felt, is particularly timely. The Heating and Plumbing Finance Corporation has published a circular giving details of its "Special Summer Plan," including a rate chart applying only to heating installations made during March to July, inclusive. This circular is available at the corporation's New York office, 37 West 39th Street, and at its Chicago office, 816 South Michigan Avenue.

Application of Heating and Ventilating Research

by **L. A. HARDING**

From an address delivered before the National District Heating Association, in St. Louis, June 3, 1930

PROGRESS in any art, measured by the improvements made in the processes involved, may be said to be entirely regulated by the amount of well-directed original research which is expended on the art—a fact which only in comparatively recent years has been fully accepted by the industries.

Engineers are happy to acknowledge the debt they owe to the work of natural philosophers and physicists, dating from Newton's time, which has made possible the practice of engineering in its many and varied branches.

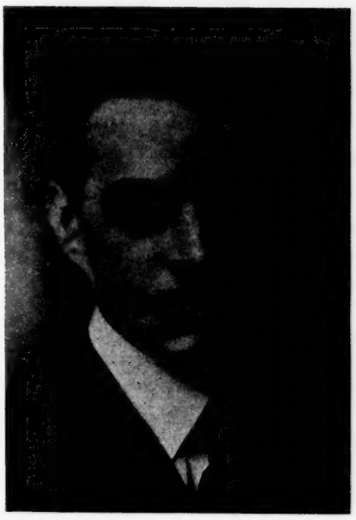
The prominent role, which purely scientific and engineering research has played in removing the art of heating and ventilation from uncertain engineering endeavor, frequently is overlooked.

The pioneer research of the French physicist, Péclet, made nearly a century ago, covering the heat conductivity and emissivity of various materials, was perhaps the first contribution of real scientific value to this art. Heat-transmission investigations and tests by many physicists and engineers have been more or less continuous since his time and there are now available conductivity values for practically all known building materials and heat insulators. Computed values of compound walls for some time were considered by this industry as somewhat academic.

The Nicholls heat meter, developed in the A.S.H.V.E. Research Laboratory, has been applied to a sufficient variety of compound walls of existing structures definitely to establish that it is a safe procedure to employ laboratory tests on materials in the calculation of the heat transmission of such walls.

The correlation between laboratory wind velocity measurement as reported by the A.S.H.V.E. Research Laboratory, and wind velocities in a free unobstructed space, as reported by the weather bureau, is now in the process of solution.

Research has furnished the engineer with a more accurate method for estimating the heat required to compensate for air infiltration based on tests of various kinds of sash with and without weatherstripping. The amount of infiltration through plain and plastered walls has definitely been established.



President L. A. Harding of the A.S.H.V.E.

In the past any heating plant that would maintain a breathing line temperature of 70° F., 5 ft. above the floor line, during coldest weather, was considered satisfactory. The occupants, however, frequently are not agreeable to this idea. They occupy a zone at an average height of 2 ft. 6 in. above the floor-line, where the air is always colder than at the breathing-line. It is often an observed fact that, although an air temperature of 70° in the 2-ft. 6-in. zone is maintained, the occupants are not in that state of well being or quiet enjoyment called "comfort."

When we say we feel comfortable we mean that a fairly exact heat balance is being maintained between the heat liberated within the body by chemical reactions and the heat leaving the body by radiation, convection and other ways. Any other condition tends to produce a change in the body temperature and we experience the sensation of warmth or of cold.

Power-plant engineers, in recent years, have become quite heat-balance minded. Heating and ventilating engineers have always been so afflicted, but frequently were unconscious of the fact.

It has been a recognized fact for some time that various combinations of air temperature, air movement and relative humidity will produce equal degrees of comfort with the enclosure surface temperature kept relatively constant at approximately 65°. One of the greatest scientific contributions to the art of heating, in recent years, is the "comfort chart" established by the A.S.H.V.E. Research Laboratory, and which has satisfactorily solved one part of the problem.

The greater percentage of body heat loss, however, is accounted for by radiation, which is dependent upon the surface temperature of the clothing and the surrounding wall temperature.

Recent research of Professors Willard and Kratz, of the University of Illinois, on wall surface temperatures observed in building construction has served to focus the attention of engineers on this neglected, but important, part of the problem dealing with comfort. It is somewhat complicated, due to the effect of solar radiation and wind movement, particularly on walls having southern exposure. The insulation of wall surfaces, primarily to reduce the heat loss of the structure, also serves the equally-important function of increasing the inside surface temperatures and, therefore, to retard the body radiation loss.

Absorption of solar radiation or sun effect on buildings has been the subject of recent investigation. This research is of growing importance as the practice of cooling buildings in summer increases.

A black roof surface exposed to the sun's rays in summer will absorb heat, at noon with a clear sky, at the approximate rate of 300 B.T.U. per sq. ft. per hr.

Due to the variation in the rate of solar radiation received, the heat capacity of the roof construction, the amount of the heat radiation dissipated to the air by convection, the amount of heat actually entering the building naturally is very considerably less than the amount absorbed. An estimate of the amount entering the building has become an item to be allowed for in all calculations involving the amount of refrigeration required in dehumidification problems.

The amount of solar energy in the form of heat that a black body will

absorb is the equivalent of approximately 5000 H.P. per acre in the tropics. It is not to be wondered that physicists and engineers have sought for over a century to transform efficiently this vast source of energy into mechanical work.

The Claude-Boucherot experiment on the north coast of Cuba, which will attempt to utilize, on a commercial scale, the temperature difference of approximately 40° F. between the surface water of the Gulf Stream and from a depth of approximately 2000 ft., is being watched with great interest by engineers.

Engineers have recently been giving some thought to the so-called "effective warming" of direct radiation. Research has developed the fact that certain types of radiator covers or enclosures, in medium-sized rooms at least, will produce the same room air temperature at, say, 2 ft. 6 in. above the floor with less steam consumption than an unenclosed radiator. This is due to the fact that the ceiling temperature is less with the cover or enclosure, with a consequent smaller heat loss throughout the ceiling and upper sections of the side walls. Some engineers have suggested that direct radiators should be rated on a basis of effective warming, rather than on the usual method of total heat emission. It is difficult to conceive how this could satisfactorily be accomplished.

Recent comparative tests on similar direct steam radiators of the same catalog rating furnished by several manufacturers have disclosed the fact that the heat emission is not the same and in some cases was found to be in excess of 15% under the catalog rating, the catalog rating in all cases being based on a heat emission of 240 B.T.U. per sq. ft. per hr.

Perhaps one of the most notable observed changes in methods of warming has been the substitution of unit heaters in factory buildings to the practical exclusion of direct and blast type radiation. Convenience, first cost and, in the case of floor type units, economy in operation have contributed to the reason for this change.

The system of panel warming patented about twenty years ago by Professor Barker, an Englishman, and consisting of hot water pipe coils buried in the wall and floor construction is now apparently making some headway in England.

This system recently was installed in the British Embassy in Washington and is the only example at present in this country. With this system comparatively large wall and floor areas are warmed to a maximum inside surface temperature of approximately 75° F. by water circulated at a temperature of 120° F. The body heat loss, as previously mentioned, is regulated to a considerable extent by radiation to the cooler wall surfaces of the room. It is claimed, with this system, that a person normally clothed will feel perfectly comfortable in a room in which the air temperature is maintained at 60° F. This is, of course, impossible with the usual installation of direct radiation.

This method of heating permits carrying a considerably higher relative humidity in the air of the room, for the same dew-point temperature as indicated by moisture precipitation on the glass of single windows, and obviously is a desirable feature not to be found in any other heating system.

Ideal System is Combination of Air Conditioning and Heating

This system of heating combined with an air-conditioned ventilating system, would appear to be an ideal arrangement, but a somewhat expensive combination to install and maintain.

Non-ferrous extended surface-type concealed radiators are supplanting the cast-iron radiator, to some extent, in homes of the better class and in some recent office buildings. Appearance and compactness are the contributing factors in this change.

Owing to the comparatively small mass of this type of radiation, the boiler is subjected to a smaller starting-up load for the same length of time allowed for the warming-up period or, conversely, for the same starting-up load on the boiler, the time for heating up the radiator very materially is reduced.

For the same reason, when automatic temperature control is employed this part of the equipment evidently is called upon to perform its function more frequently.

Manufacturers of cast-iron radiation reported sales of 139 million square feet for 1929, so that it cannot be said that this type of direct radiator has become entirely obsolete.

Extended-surface copper coil blast radiation, to a very large extent, has supplanted the cast-iron type, which for many years was considered standard in the blast field.

Compactness, less labor required for installation and less weight to be carried by the supporting structure of the heater have been the contributing factors for its wide adoption in this field of heating. There has recently been placed on the market, by several manufacturers, a combination of floor-type unit heater and humidifier, complete with temperature and humidity control, which is finding a ready market in many industries.

The past twenty years have witnessed the birth and progress of the air-conditioning industry from an experiment to its present highly-developed state. Development of this branch of the heating and ventilating industry owes its advancement principally to research covering the control of psychrometric changes in the atmosphere and the development of the rational Carrier psychrometric formulae resulting from this research. Perhaps the greatest contribution made to the art, during the past fifty years, may be said to be air conditioning.

It has been responsible, in industry, for the improvement made in the quality of many manufactured products and in some industries it is essential to the process.

In many cases it is responsible for the acceleration of the process, the elimination of economic loss due to material waste and the reduced efficiency of the employees, as a result of uncontrolled temperature and relative humidity.

In order to maintain a fairly constant relative humidity within a structure the year around, dehumidification is essential and requires refrigeration.

The successful cooling of theatres during the summer months and the control of temperature and relative humidity in assembly halls have required the correct solution of many new, varied and somewhat complicated problems.

It is of interest to note that the recent large installations of air-conditioning apparatus, serving the House and Senate in the National Capitol Building and many other installations, are regulated in conformity with the requirements of the A.S.H.V.E. Comfort Chart.

It is growing more apparent that the comparatively simple process of warming the interior of a building *does not* fully meet up with our present day standards of living and comfort. Measuring the great majority of systems now in use by these standards, how few installations could qualify as satisfactory.

There are some who apparently confuse comfort with health and consequently have criticized the engineers' standard for comfort. The Comfort Chart is not a complete measure of a healthful atmospheric condition and the engineers have never made any such claim. It is perfectly obvious, however, that a heating system should promote comfort with no detriment to our health. The air we breathe naturally should be comparatively free from dust, odors and bacteria.

The synthetic air chart, devised by Dr. E. V. Hill as a measure of what is termed ventilation, is the only yard stick in existence which takes into account many of the contributing factors now thought to constitute good, bad or indifferent ventilation.

We delight in giving credit to our

world-renowned scientists in their apparent solution of the fundamental structure of the atom and consequently all matter. It appears strange, however, to us laymen, that scientists and physicians cannot tell us today just what are the so-called vital characteristics of air, perhaps the most important and certainly most universally employed combination of elements which contribute to our existence.

A recent European laboratory experiment, made upon three groups of small animals, disclosed the rather surprising fact that the group supplied with an accurately-prepared mixture of pure oxygen and nitrogen in the proportion usually found in the outside air died within a few hours.

Research work has been started at Yale University in co-operation with the A.S.H.V.E. Research Laboratory in an attempt to solve the "vital characteristic" mystery.

Only future research can disclose the facts upon which engineers may build into a ventilating system the required apparatus to produce an artificial atmosphere, which can safely be said to equal that supplied by Nature in its so-called health-giving qualities.

It is not, I believe, unreasonable to suppose that artificially-created atmospheres will be employed in the future to prevent, treat and combat some of the ailments of mankind susceptible to treatment through the medium of the lungs.

The accumulated knowledge of this art cannot be said to be applied today in a complete form to the heating and ventilation of the home, apartment house or office building.

What today may seem a luxury, tomorrow frequently becomes a necessity. The American public have been educated through the medium of advertising to the employment of a great variety of so-called home comforts, consisting principally of electrical appliances of various kinds.

It cannot be said that the manufacturers of heating equipment have kept pace with the public demand for a heating system which eliminates the very apparent and inherent defects of the existing systems.

In the light of our present knowledge of this art, the central fan-blast humidity-controlled system appears to offer the nearest approach to a practical solution of the problem.

This system with complete automatic control is now being installed in a large number of high grade homes with apparent satisfactory results. Public demand in the near future undoubtedly will bring about a very decided change in heating methods and along with these changes we may expect to witness better business for this industry, due primarily to the replacement of existing installations that have become obsolete.

St. Louis Newspaper Advertising Features Air Conditioning

Under the title "Conditioned Air," the various manufacturers, contractors and utilities engaged in heating, air conditioning and ventilating in St. Louis, have been running a series of full-page advertisements in the St. Louis Post-Dispatch, one each week for five consecutive weeks. Conditioned air was described as "establishing an atmospheric condition conducive to health and industrial advancement."

A quarter of the page was devoted to an article by some authority on the subject, an example being the issue of June 15, in which Dean Paul Anderson discusses "The Day of Air Conditioning."

Others who contributed keynotes to the advertisements were Willis H. Carrier, president of the Carrier Engineering Corporation; Herman W. Nelson, president of the Herman Nelson Corporation; Arnold J. Hecker, of the St. Louis Refrigerating and Cold Storage Company, and H. F. Herman.

Around each article were grouped advertisements by local branches of manufacturers, one by the Heating and Piping Contractors St. Louis Association, listing the Certified Heating contractors, and others by oil-burner dealers, ventilating contractors, etc.

Public Health Service to Study Air Pollution

According to David R. Morris, observatory meteorologist at the United States Meteorological Observatory in Central Park, New York, the United States Public Health Service will undertake a study of air pollution in twelve American cities, using air filters similar to the one in Central Park.

Mr. Morris also announced that there was more dust in New York air in June than in any month in this year. The average pollution for June was 2.1 lbs. per million cubic yards of air, a 45% increase over May, and a 9% increase over the former record month, February. As wind velocity goes down, Mr. Morris said, pollution goes up, and June had the lowest wind velocity of the year, with southwest winds prevailing. Southwest, west and northwest winds are the greatest bearers of air impurities.

The greatest amount of pollution in the air at any time in June and in any given short period of the year occurred in two one-hour periods on June 24 when, from midnight to 1 A. M. and from 2 to 3 A.M. there were 4.3 lbs. of dust per 1,000,000 cubic yards of air.

Mr. Morris said he was not thoroughly familiar with the details of the national pollution survey to be conducted by the Public Health Service, but that Dr. James E. Ives, physicist attached to the Division of Industrial Hygiene and Sanitation of the service in Washington, and who was to direct the studies, had called on him recently and told him some of its details. Doctor Ives stated that the survey would continue in the twelve cities, as yet not chosen, for about a year and that the service has $25,000 available for the purpose.

Doctor Ives was pleased with the accuracy of the air filter used in Central Park and said that like instruments would be used in the national survey. In 1927 Doctor Ives was one of the scientists who measured the length of daylight as affected by New York's smoke pall, and he hopes to get new data on this subject from the survey. Data will also be made available to the municipal authorities of the cities studied.

Doctor Ives also spoke of making a local study of atmospheric ultra-violet radiation, but has made no definite plans for that as yet.

The New Crane Budget Plan

Stimulation of sales of heating and plumbing materials, on a basis of monthly payments, is the object of the Crane Company's "New Budget Plan." It is being brought to the attention of the public through a national advertising campaign. According to the company's announcement, all sales will be made through financially-responsible and mechanically-competent heating and plumbing contractors, who will be known as "Crane qualified contractor-dealers."

The plan provides for the financing, by the company, of the complete cost of a job, including materials, installation, overhead and contractor's profit, for 10% down, the balance to be paid monthly by the customer over a period up to twenty-four months. In rural districts with less than 10,000 population, down payment is only $5, with up to thirty-six months to pay the balance.

As soon as the customer's note and required forms are sent in by the contractor to the Crane branch, the contractor is credited with all the money due him and his balance is paid in cash. Subsequent routine collections are made through the First Bancredit Corporation, a financing company, which will discount Crane Company's paper.

Each Crane branch will operate the plan in its own territory. Crane salesmen have received the necessary instructions, as have contractors qualified under the plan.

Legal Decisions

Steam Heat Consumers Must Bear Expense of Service

In granting the application of the Illinois Power and Light Corporation increased rates for steam-heating service in various communities the Illinois Commerce Commission said: "The principle is well established that each utility service in a community shall, as far as possible, pay its own way, and the utility company in the determination of its electric and heating rates is not justified nor will it be permitted to impose on the electric consumers as a group any part of the burden of expense of maintaining and operating the heating system."

Authority of Agent Selling Oil Burner to Substitute Oral Contract for Written Contract

In an action for the price of oil tanks sold and delivered to the defendant and set up in his property to be used in connection with an oil burner, the Rensselaer (N. Y.) County Court, Socony Burner Corporation v. McClare, 134 Misc. 58,235 N. Y. Supp. 290, holds that a written contract for the sale and installation of an oil burner and equipment, including a tank, being executory before the installation, could be cancelled by mutual oral agreement between the parties. The defense was that after the agreement was signed, but before the installation, an alleged cancellation of the contract was brought about through conversations had between the same salesman and district manager who had negotiated the written contract on behalf of the plaintiff and by defendant in his own behalf, and a new arrangement made orally that the plaintiff install the burner, equipment and tank upon the understanding that if the burner did not operate satisfactorily to the defendant, he would not be required to pay anything for any part of the equipment, which would be removed by the plaintiff.

The main facts not being disputed, the only question at issue was whether the salesman and district manager had a right to bind his company in canceling the original contract and making a new oral contract. It was held that he was apparently acting within the scope of his authority, and the customer had a right to assume that he had authority to do what he undertook to do. On notice that the burner was not satisfactory, the plaintiff removed it and certain parts of the equipment, and was now seeking to recover for the price of the tank under the original agreement, the tank not being removed. It was held that, upon the proof, the complaint should be dismissed.

The defendant counterclaimed for $54, the amount paid on account. It appeared that when he asked about the return of this sum, if the burner was not satisfactory, he was told by the company's representatives that it would go towards paying for the oil used in the burner. The counterclaim was therefore dismissed.

Consideration for Oral Guarantee of Heating Plant

Two promissory notes were delivered in connection with a contract for the installation of an oil-heating system. The written contract contained no agreement that the system should be satisfactory. It provided that the first note should be given when the oil tank was installed and the second on completion of the work. The first note was delivered before the tank was installed, and there was evidence which would sustain a finding that, in order to obtain it at that time, the plaintiff agreed that the system should be satisfactory. In an action on the notes, Fall River Oil Heating Co. Inc. v. Gildard, 164 N. E. 382, the defense being that the notes were to be paid only if the defendant was satisfied with the contract, the Massachusetts Supreme Judicial Court held that evidence of the oral agreement alleged by the defendant could be submitted to the jury and given such probative force as it possessed, and that the written contract could be modified after its execution by oral agreement based upon consideration. The giving of the first note before the time called for in the original contract could be found to be a sufficient consideration for a modification adding an agreement that the system, or the work, should be satisfactory to the defendant, and if not that he might refuse payment of the notes. The questions whether such agreement and modification were made and whether the work was satisfactory were held for the jury. The case did not turn upon the construction of the original contract and whether oral evidence could be admitted to affect that construction; nor, necessarily, upon whether the giving of the second note was such acceptance of performance that no defense to it was open.

Landlord Held Not Liable for Steam Explosion from Radiator

An action against the owner of rented premises by a child for injuries sustained by a steam explosion from a radiator caused by the act of the tenant in turning on the heat after admitted knowledge that the air valve had become loose so as to render the radiator dangerous, after the radiator had been shut down on account of such danger, was that of Kleinberg v. Lyons, Georgia Court of Appeals, 148 S. E. 535. The court held that the act of the tenant did not consist merely in contributory negligence in continuing to occupy a portion of the rented premises after knowledge of its dangerous condition, barring a recovery on the tenant's part, but was the proximate cause of the injury, such as would prevent recovery on the part of any person claiming damages on account of the failure of the landlord to perform his duties to the tenant. It could not be reasonably supposed that the landlord could have foreseen that the tenant, knowing of the defect and danger reported to the landlord by herself, would turn the steam back into the radiator in its dangerous and defective condition. One judge dissented on the ground that it was not conclusively established by undisputed testimony, as a matter of law, that the tenant turned the steam into the radiator with knowledge of the attending danger, and that therefore her act in so doing was an agency independent of any act of the landlord and was the proximate and solely responsible agency causing the resulting injury to the plaintiff.

Contractor's Surety's Conditional Agreement

The Texas Court of Civil Appeals holds, Kinnison Bros. v. Steger, 11 S. W. (2d) 527, that the agreement of the surety of a contractor for the construction of a church, where it became necessary for the surety to see that the building was completed, to pay the balance due on a steam-heating plant installed in the church, being dependent on condition of the surety receiving money from the church with which to pay for the plant, the sellers of the plant had the burden of proof, in an action by them against the surety, to establish the happening of the events upon which the condition was based. It is held that the plaintiffs were not entitled to recover on the agreement where it was not shown that the defendant had received from the church money in any amount which he could apply upon the plaintiffs' debt. It seemed that the contract price of the building was otherwise exhausted in construction.

Heating Comfort Through Automatic Control

by **LORIN W. SMITH, Jr.**

HEATING comfort through automatic control is merely applying those factors now available to the coal industry to the proper fuel utilization of coal. You, as fuel merchants, in the final analysis, have only one thing to sell; and that is modern heating comfort as it may be obtained from coal.

As fuel merchants you should be fuel merchandisers. As merchandisers you immediately compete with all other forms of business striving for the consumers' dollar. Fortunately you have a marked advantage in the fact that your product is an essential in the structure of modern economic life.

The entire coal industry is now beginning to realize that the job of maintaining its leadership in the heating industry is getting bigger and longer and harder than anticipated.

What does the term merchandising really mean? Merchandising is the term applied to the active solicitation of patronage by stimulating consumers to purchase a specific product, and by formulating and executing comprehensive and consistent plans for economically and effectively distributing the product to the consumer.

There are many ways of marketing that the coal dealer may apply to his regular products which make it seem a distinctly different product, all because he has studied his consumer outlets and has found out how they will best accept and receive that which he has to offer. By catering to the popular appeal of courteous personal service, the coal retailer can cultivate a profitable clientele.

Where in the past the coal retailer has not interested himself in the type of heating plant that consumes his fuel, today, we find the aggressive merchandiser making a careful survey of all heating plants in his marketing area, to determine what type and size of fuel will give the best satisfaction through proper fuel utilization. On such surveys the aggressive coal merchant employs the use of a simple draft gauge to detect faulty chimneys and flue construction. The use of a simple smoke test applied to questionable chimneys often eliminates future trouble and complaints which, incorrectly, have been attributed to the fuel used.

Instead of "passing the buck" to his fellow tradesman, the heating contractor, the coal merchant is working with him in the mutual effort of providing modern heating comfort for the consumer. By such a coordinated activity many pitfalls such as antiquated heating equipment, unsatisfactory installations and improper chimneys are being eliminated instead of awaiting the product of the unsuspecting fuel merchant.

There are many of your customers who, today, do not realize the economies they might effect in the proper utilization of fuel. Then, too, there are many who think that they can only get automatic control of temperature through the adoption of the newer forms of heating. Why is this so? Simply because the newer forms of heating have stressed all the advantages of comfort, convenience and even temperatures that are available with their products, to such an extent, that the home-owner naturally feels that they apply only to these types of heating.

The best thing for the coal merchant to do is to inform his trade that all the comforts of automatic temperature regulation are available for use with coal, in fact were originally developed for use with coal-fired heating plants.

This will apply to the majority of the domestic heating plants, but there are a large number of coal-fired heating plants, the owners of which should be educated in the use of automatic coal stokers as a means of providing greater convenience, comfort and economy.

Your fellow tradesman, the heating contractor, is the man to whom you should direct your efforts in seeking his assistance in educating the consuming public to the proper utilization of coal through automatic equipment.

The objective being known, it is now up to the coal merchant to cast aside his attitude of passive merchandising and institute an active campaign of modern merchandising, having as its battle cry, "modern heating comfort as it may be obtained from coal."

The leaders of your industry have recognized the trend of activity which is not alone sweeping through the coal industry, but through American economic life like a prairie fire and are fostering a movement which has as its ultimate goal the coordination of effort of all factors pertaining to the heating industry, in obtaining modern heating comfort through the proper utilization of coal.

The National Coal Association, as it represents the majority of the bituminous operators, has been active in sponsoring coordinated effort between the coal and heating industries.

Through this activity, both the coal and heating industries are realizing the underlying reasons for the tremendous success of this country, and that the success of all our great leaders of industry has been the degree to which they have either consciously or unconsciously coordinated their efforts in the interests of those classes upon whom they depended for their success.

Let us go back and sketch the activity of the National Coal Association up to this time.

Last October, at their annual meeting held at Cincinnati, the National Coal Association had presented to them a suggested plan whereby they take the initiative in gathering together representatives of the related industries into a conference which would study and develop practical merchandising plans that would carry to the ultimate consumer the story of personal comfort as it might be secured through the use of bituminous coal. The suggestion was well received and immediate plans were formulated to start such a movement.

The warm-air furnace industry was quick to realize the opportunities, and at the semi-annual convention of the National Warm-Air Heating Association a committee was appointed to meet with a committee representing the National Coal Association.

This meeting of representative committees of the coal and furnace industries, held in Philadelphia, brought out several fundamental principles on which the coordinated activities of the two industries could be effectively centered.

Foremost of these principles was the recommendation of an adequate, standard chimney ordinance framed to provide proper draft conditions for fuel consumption. Furnace defects and improper firing or selection of coal were

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Abstracted from a paper presented at the forty-fourth annual convention, Illinois-Wisconsin Fuel Merchants' Association, Rockford, Ill.

also accredited as common factors for the major burden of domestic fuel complaints.

Following close on the heels of this conference, representatives of the furnace and boiler industries began appearing on the programs at coal conferences. Perhaps the outstanding example of this occurred at Purdue University recently when both representatives of the National Warm-Air Heating Association and the Heating and Piping Contractors National Association appeared on the program of the Midwestern Bituminous Conference.

The next development of coordinated activity occurred when C. B. Huntress, executive secretary of the National Coal Association, appeared on the program of the annual convention of the National Warm-Air Heating Association in Detroit. In a key-note address stressing cooperative sentiment from the standpoint of the coal man, Mr. Huntress commented on the recent meeting between the industries and foresaw many more meetings in the future.

He further stated that a plan of cooperative methods between the coal merchants and furnace men was being evolved. The details, however, were not dwelt on, but it was obvious that by virtue of the common background and a like objective, namely, maximum heating satisfaction—joint effort, intelligently and vigorously directed, would be of far-reaching results.

And now, just this past month, has occurred the most outstanding contact between the coal and heating industries, namely, a joint conference between appointed committees representing the following industries:

National Coal Association.
National Warm-Air Heating Association.
National Retail Coal Merchants Association.
Institute of Boiler and Radiator Manufacturers.
Heating and Piping Contractors National Association.
Anthracite Institute.
Stoker Manufacturers Association.
American Wholesale Coal Association.
Midwest Stoker Association.
Accessories Industry.

This meeting, which was held at the Union League Club, Chicago, May 8, under the auspices of the National Coal Association, agreed upon a number of fundamental handicaps that have held back the use of coal and heating equipment. Enthusiastic approval of a coordinated plan on the advantage of using coal with modern coal-burning equipment was unanimously adopted.

This meeting, I believe, marked the beginning of a new era in promoting a better, more intelligent utilization of fuel as well as assuring the public of authoritative information on modern heating comfort and greater satisfaction in the use of coal.

The significance and far-reaching importance of this meeting will be understood when it is realized that for the first time in history outstanding leaders representing ten nation-wide organizations in the coal, warm-air, boiler and stoker industries gathered around the table to discuss seriously the fundamental causes that bring about public dissatisfaction with their heating plants and the use of coal.

Endorses "Standard Code" and "Certified Heating"

Remarkable unanimity of opinion prevailed throughout the conference, and every one present enthusiastically welcomed the suggestion for coordinated activity on the part of the coal and heating industries in a joint effort to eliminate complaints and increase the sale of adequate heating equipment, properly installed, according to the "Standard Code" for Warm-Air Furnaces and "Certified Heating" for Steam and Hot Water Plants.

Analyzing the events of the last two months, you can readily realize that the coal industry is no longer on the defensive but is very definitely on the offensive.

Such an offense, emanating from a national source, is worthy of your unqualified backing—first, by your moral support as an association, and then through the practical application of coordinated merchandising to each individual community.

The lead that the National Coal Association has taken will not be effective until each individual local coal organization puts into active practice the policy of coordinated merchandising with the retail heating contractors.

Then, and not until then, will the coal men cease to blame the furnace man and the furnace man, tinners, and others blame the coal man for faulty heating. Work out a plan with your furnace dealers and heating contractors whereby they can service complaints which you run across in your business. This plan has worked out in several communities very well; in fact, I know one city where coal retailers turned over to one furnace dealer over ten thousand service jobs a year.

By working out such a service in your own communities you will not only hold your customers, but it also will relieve you of all servicing work, and thereby secure greater satisfaction for all concerned.

There are many principles of combustion in varying types of furnaces and boilers which you may not know of. Get acquainted with the furnace and boiler man and learn all you can about his products. He, too, will no doubt welcome information on the fuels that you have to sell.

In some communities progressive coal merchants have called together in a joint meeting all the coal dealers, heating contractors, furnace installers, accessory merchants, etc., and have frankly discussed the opportunities of coordinated effort. The results have been that the furnace man, when he ran into a combustion difficulty, called in the coal man for a conference and, instead of passing the buck to each other, collectively found the difficulty and by correcting it served a satisfied customer. Likewise when the coal merchant runs into difficulty and knowing his coal not to be at fault can by calling in the furnace installer check up on the difficulty and further retail consumer satisfaction.

The sooner the individual coal retailers and heating contractors meet on a common ground of coordinated activity, and work together in providing satisfactory automatic heat, the sooner the coal industry will be able to regain its lost ground.

May I suggest to you coal retailers present that on your return home you put into practice a plan of coordinated activity with your fellow tradesman—the heating contractor, furnace installer, plumber, or accessory salesman—and sell him on the advantages of working with you in providing modern heating comfort through the proper use of coal.

New Edition of "This Way to Profits"

Due to the continued demand from the heating and plumbing industries for the booklet "This Way to Profits," issued by the Heating and Plumbing Finance Corporation, the first printing of 50,000 has been entirely exhausted, making it necessary to publish a new edition.

A feature of the new edition of this booklet, which is devoted to the time-payment plan sponsored by the American Radiator and Standard Sanitary Corporation, is a section devoted to the lower revised rates and the new summer plan for obtaining business during the period when business is likely to be slack. According to this plan no payment is required on the part of the purchaser until fall, other than a small down payment. Both of these features are developments since the first edition was printed.

Copies of the booklet are available through any of the company's salesmen or from the Heating and Plumbing Finance Corporation, 37 West 39th St., New York, and 816 South Michigan Ave., Chicago, Ill.

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Every fourth month HEATING AND VENTILATING will appear as a Reference Number — each a complete treatise on a particular class of building. This will bring to the heating and ventilating engineers and contractors articles on the latest design and practice of the specialists in that field.

The Reference Numbers will supply the industry with a self-perpetuating library of incalculable value.

The ten subjects in the schedule below will be repeated in a cycle every three years — an original editorial content for the heating and ventilating industry, containing complete and specific data not available previously in either book or periodical form.

SCHOOL BUILDINGS — **CHURCHES** — **OFFICE BUILDINGS**

THEATRES — **PUBLIC INSTITUTIONS AND BUILDINGS** — **HOSPITALS**

INDUSTRIAL BUILDINGS — **HOTEL AND APARTMENT BUILDINGS**

TRANSPORTATION BUILDINGS — **DEPARTMENT AND OTHER STORES**

in September—

SCHOOL BUILDING REFERENCE NUMBER

HEATING AND VENTILATING

September 1930 Issue

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by Thomas F. Dwyer, Mechanical Engineer, Heating and Ventilating Division, Board of Education, New York.
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Control of Air Conditions in School Buildings
by John Howatt, Chief Engineer, Board of Education, Chicago.

Trends in School Heating Practice
by Samuel R. Lewis, Consulting Engineer.

School Ventilation—A Dialogue
by H. W. Schmidt, Supervisor of Buildings, Wisconsin State Department of Public Instruction.

School Ventilation from the Superintendent's Viewpoint
by Joseph A. Ewart, Superintendent, Stamford, Conn., Public Schools.

Air Distribution and Temperature Control
by Thomas J. Duffield, formerly Executive Secretary, New York Commission on Ventilation.

Heating and Ventilating a New School for Social Research

An Analysis of State Laws Relating to Ventilation

Tabulation of School Heating and Ventilating Cost Data with Total and Unit Costs on Installation and Operation

Bibliography of School Heating and Ventilating in the United States since 1923

Committee of Ten Organized to Promote Use of Solid Fuels

An important organization of representatives of the coal industry and of the heating equipment and accessories industries was effected in Chicago, June 17, when the Committee of Ten—Coal and Heating Industries was organized. The committee will devote its activities to the formulation of plans, recommendations and suggestions to the industries which it represents.

One of the ways in which this service will be rendered is through personal contact between respective members in any locality, and the establishment of standards, if they are not already in existence, by which its product and practice may be judged.

The interests represented and the membership of the committee are made up of the following: National Coal Association, H. A. Glover, general manager of sales, Consolidation Coal Co., 15 Broad St., New York; Anthracite Institute, Carlyle M. Terry, manager, Anthracite Coal Service, 30 North La Salle St., Chicago, Ill.; American Wholesale Coal Association, L. H. Dayhoff, president, Republic Coal & Coke Co., 28 East Jackson Blvd., Chicago, Ill.; National Retail Coal Merchants' Association, Richard Miller, Miller & Banker, 6543 Wentworth Ave., Chicago, Ill.; National Warm-Air Heating Association, E. B. Langenberg, president, Langenberg Mfg. Co., 4519 Euclid Ave., St. Louis, Mo.; Heating and Piping Contractors National Association, H. M. Hart, L. H. Prentice Co., 1048 West Van Buren St., Chicago, Ill.; Institute of Boiler and Radiator Manufacturers, Homer R. Linn, American Radiator Co., 816 South Michigan Ave., Chicago, Ill.; National Sheet Metal Contractors Association, George Harms, secretary, F. Meyer & Bros. Co., Peoria, Ill.; Midwest Stoker Association, H. H. Kurtz, branch manager, Iron Fireman Mfg. Co., 570 West Randolph St., Chicago, Ill.; Accessories, Lorin W. Smith, Jr., Minneapolis-Honeywell Regulator Co., 4625 Portland Ave., Minneapolis, Minn.

Officers elected are: Chairman, H. A. Glover; vice-chairman, E. B. Langenberg; treasurer, George Harms; secretary, Lorin W. Smith, Jr.

Specifically the object of the committee will be to serve the public more fully by promoting heating satisfaction with solid fuels.

In the discussion which preceded the organization of the committee it was brought out that much good can be accomplished through contacts in various cities and towns between coal merchants, dealers in heating and ventilating equipment and heating contractors. It was felt that there is a very fertile field for constructive work through these local contacts in the promotion of automatic heat, in the servicing of complaints, in the setting up and enforcement of local standards and in publicity. The committee intends to outline and furnish programs and material for regional and local meetings and to cooperate fully with that movement.

Among the sub-committee appointments are the following: Regional and Local Meetings, Messrs. Langenberg, Smith and Miller; Ways and Means, Messrs. Harms, Glover and Langenberg; Standards of Product and Practices (representing coal heating and stokers and accessories) coal, Messrs. Terry, Miller and Nienaber; heating, Messrs. Linn, Harms and Langenberg; stokers and accessories, Messrs. Kurtz and Smith; Publicity and Speakers, Messrs. Smith, Kurtz and Terry; Joint Service, Messrs. Hart, Linn and Terry.

One of the significant items in its announced policy is that "each industry shall confine itself to the solving of its own problems and the marketing of its own goods without indulging in unfair criticism of the other allied industries."

Committee of Ten to Collect Data on Coal-Heating Apparatus

At a meeting of the Committee of Ten of the Coal and Heating Industries, held at the Union League Club, Chicago, July 21, it was decided to assemble all available data on apparatus which will burn solid fuel smokelessly. As an initial service, all information available on flue construction is to be assembled for compilation and future distribution through architects and the construction industry. It was announced that the work of the Committee of Ten has already been financed for the first six-month period by the associations participating.

Plans were made whereby dinner meetings will be held during the month of August in Cincinnati, Peoria, Scranton, Racine and Minneapolis, to set forth the aims and objects of the parent organization. In so far as possible the inaugural series of meetings will be restricted to cities where the coal and heating industries have affiliated through their national associations cooperating in this movement.

The meetings will be organized by national representatives and invitations issued to all individual merchants or contractors engaged in these lines regardless of membership in any national organization.

In addition to the regular committee, representatives of the American Farm Bureau Federation appeared and detailed their home modernization program as it would tie in with the general coal and heating industries.

At the annual meeting of the National Coal Association, to be held in Detroit, E. B. Langenberg, vice-chairman of the Committee of Ten, will elaborate on the activities of the Committee of Ten before the coal operators.

Any communications relative to the work of the Committee of Ten should be addressed to the secretary, Lorin W. Smith, Jr., Box 479, Goshen, Ind.

New Oil Heat Group Has First Meeting

At the first weekly meeting of the Rochester Oil Heat Association, held July 9, at the Chamber of Commerce, the following officers were elected: President, J. B. Currie; vice-president, L. F. Williams; treasurer, Charles Kenning; secretary, M. A. Ernisse. The president then appointed a membership committee composed of Charles Kenning, M. A. Ernisse and W. F. McNulty, and an advertising committee composed of C. A. Draude, Ford Hadley and W. F. McNulty.

An address on the work of similar organizations throughout the United States was given by D. G. Spahr of the Cleveland Steel Products Company. Mr. Spahr was elected the first honorary member of the Rochester association.

The association has as its object the promotion of the spirit of amity and cooperation among its members, dealers in oil-heating equipment and fuel oil, and the dissemination of accurate and reliable information and statistics concerning the oil-heating industry to the end that the public may be better informed and have a better appreciation of oil heat.

Seventeen members were in attendance at this first meeting.

One in Every Forty Homes Heated with Oil

According to a report just issued by the American Oil Burner Association, there are 535,000 oil burners installed in the country today, and at the present rate of increase there will be 655,000 domestic oil burners in use in 1931. There were only 12,500 homes heated by oil burners in 1921.

The enormous strides made by this industry in the domestic heating field is demonstrated by the fact that since 1921 the annual consumption of fuel oil in American homes has increased from 600,000 barrels to 29,790,000 barrels, or 1,250,000,000 gals.

Illinois leads the country in the number of burners in use today. More than 131,000 or 24½% of all the domestic burners in the country are warming homes in that state.

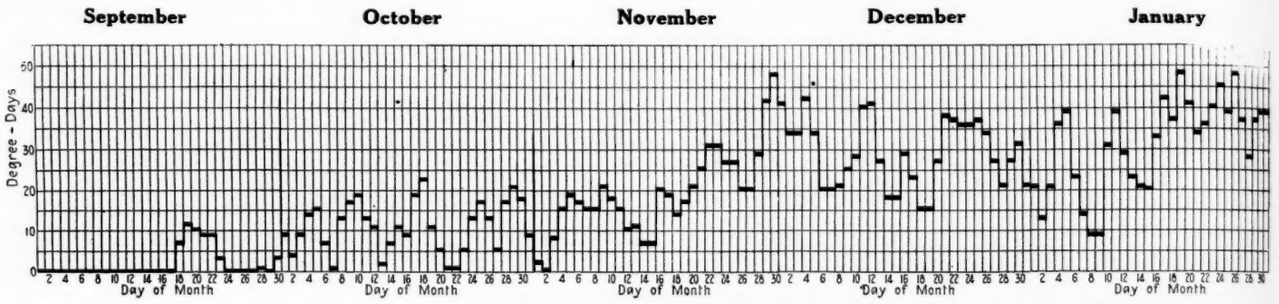
Degree-Day Charts and Data

ON these and the following pages are presented the charts showing the degree-day load in nine typical cities of the United States for the heating season of 1929-30, together with the fuel consumption figures per square foot of steam radiation for the season.

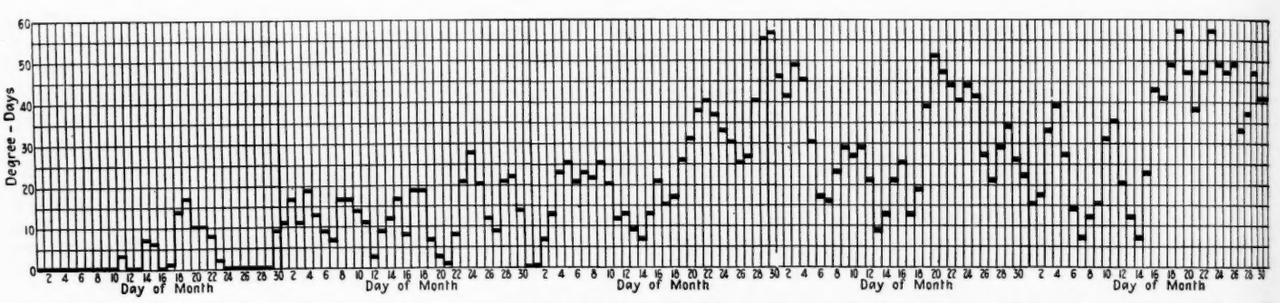
The unit fuel figures are based on an efficiency of 100%, 0°-70° design temperatures and heating values of the fuels as follows: Gas, 1000 B.T.U. per cu. ft.; coal, 12,000 B.T.U. per lb.; oil, 140,000 B.T.U. per gal. Corrections must be made for systems other than steam, for outside design temperatures other than 0°, for actual efficiencies, and for heating values other than listed.

San Francisco showed the greatest variation from the average of any city, the degree-day load being 30% less than the fifty-year average. Boston experienced a mild winter, with the degree-day total 9.3% below normal, while New York showed a decrease of 5.2%. Denver showed an increase above normal of 5.1%. The comparisons follow:

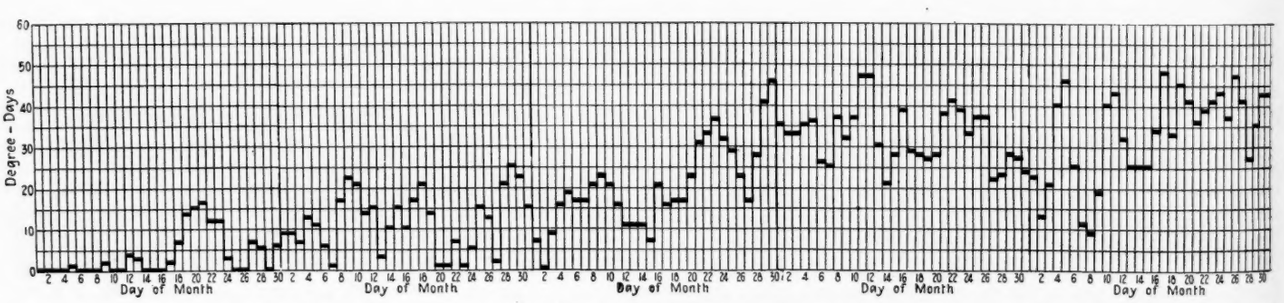
City	Degree-Days Season 1929-30	Average Season	Change from Average
New York ..	5072	5348	— 5.2%
Boston	5576	6145	— 9.3%
Pittsburgh ..	5363	5235	+ 2.5%
San Francisco	2282	3264	—30.0%
Minneapolis .	7877	7851	+0.33%
Chicago	6248	6315	+ 1.1%
St. Louis ...	4518	4585	— 1.5%
Denver	6171	5873	+ 5.1%
Seattle	4782	4868	— 1.6%



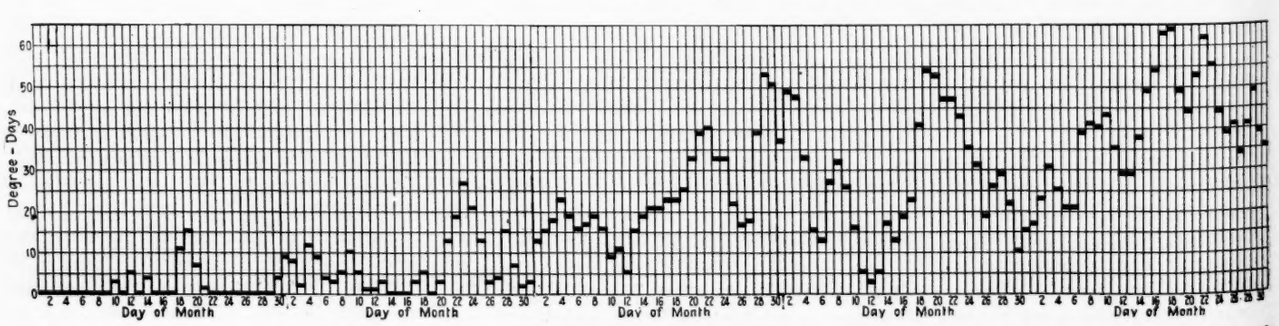
New York, Total Degree-Days, 5072, Amount of Fuel per Square Foot of



Pittsburgh, Total Degree-Days, 5363, Amount of Fuel per Square Foot of



Boston, Total Degree-Days, 5576, Amount of Fuel per Square Foot of

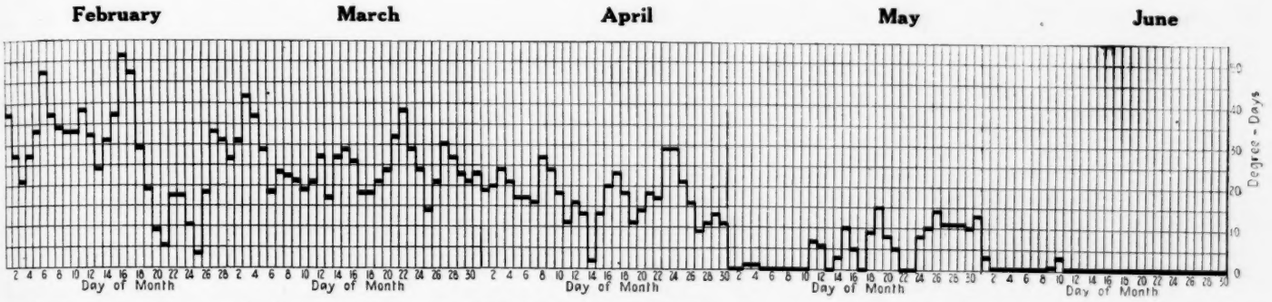


St. Louis, Total Degree-Days, 4518, Amount of Fuel per Square Foot of

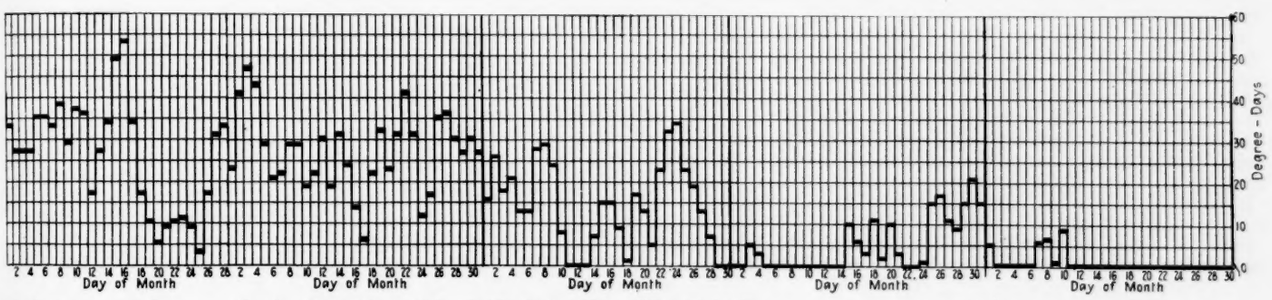
for Heating Season of 1929-30

MONTHLY DEGREE-DAY DATA FOR JUNE, 1930

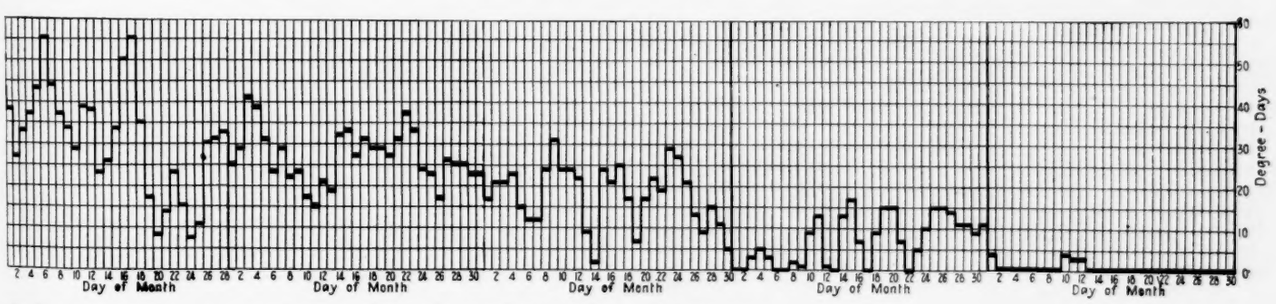
City	Degree-Days for June	Fuel Consumption per Sq. Ft. of Radiation: Lbs. of Coal	Gal. of Oil	Cu. Ft. of Gas
New York	7	0	0	0
Boston	14	0.12	0.010	1.34
Pittsburgh	29	0.23	0.020	2.79
Chicago	43	0.34	0.030	4.13
Minneapolis	31	0.25	0.021	2.98
Denver	31	0.25	0.021	2.98
San Francisco	153	1.23	0.105	14.70
St. Louis	9	0	0	0
Seattle	205	1.69	0.141	19.70
Los Angeles	10	0.08	0.007	0.96
Baltimore	0	0	0	0
Philadelphia	1	0	0	0
New Orleans	0	0	0	0
Atlanta	2	0	0	0
Cleveland	41	0.33	0.028	3.94
Cincinnati	17	0.14	0.017	1.63
Detroit	36	0.29	0.025	3.46



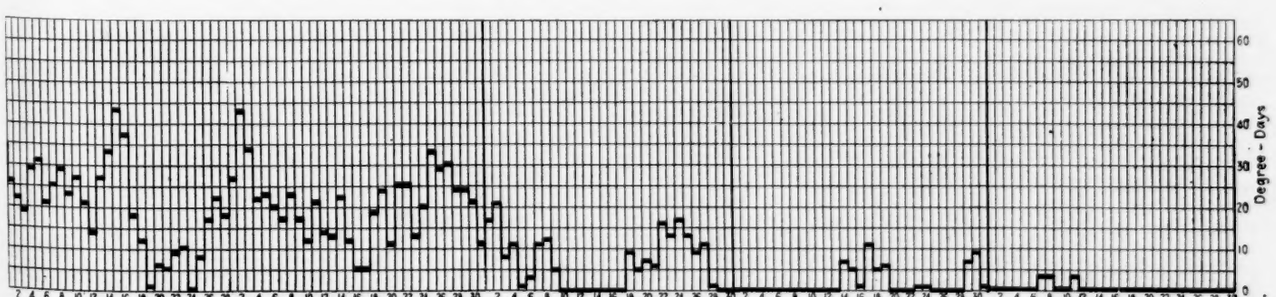
Radiation per Season: Coal, 40.6 Lbs.; Oil, 3.50 Gal.; Gas, 487 Cu. Ft.



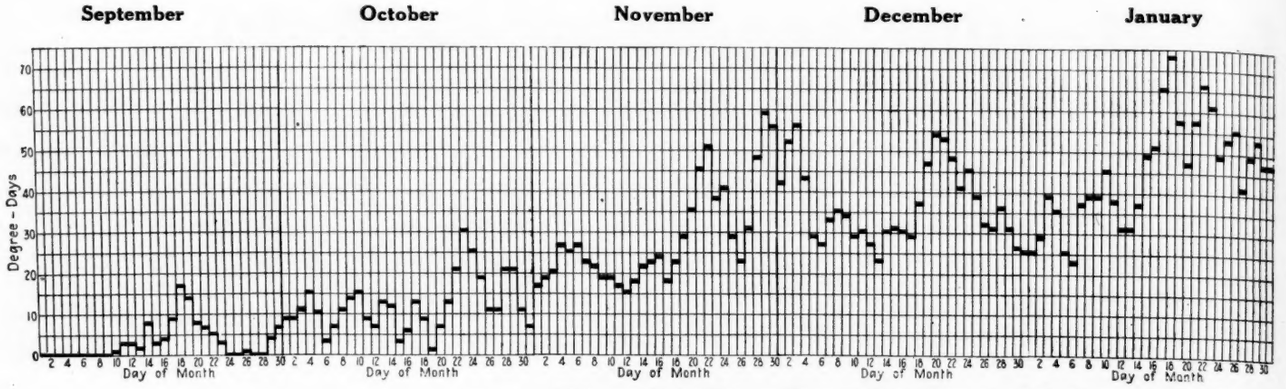
Radiation per Season: Coal, 42.9 Lbs.; Oil, 3.68 Gal.; Gas, 515 Cu. Ft.



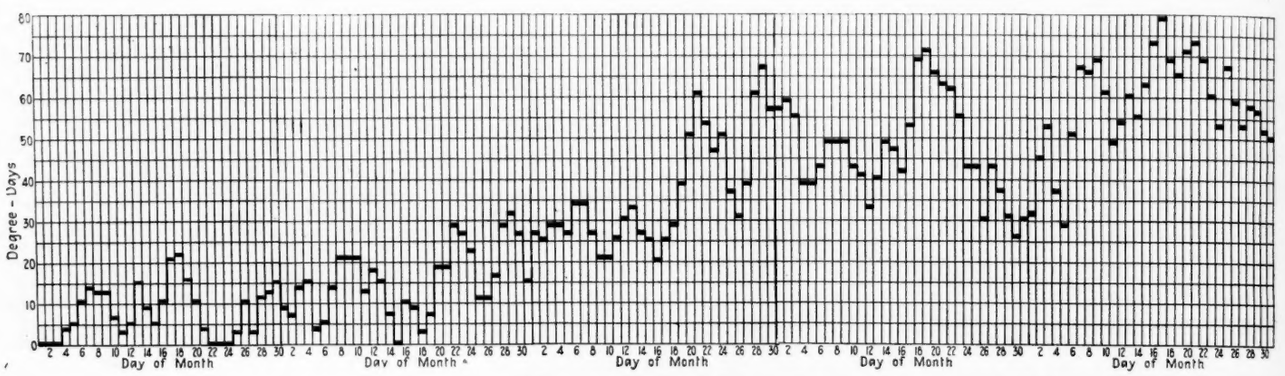
Radiation per Season: Coal, 44.6 Lbs.; Oil, 3.80 Gal.; Gas, 558 Cu. Ft.



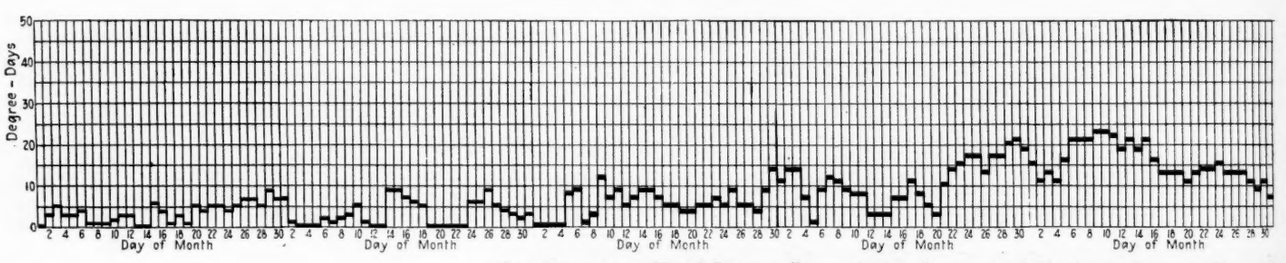
Radiation per Season: Coal, 36.1 Lbs.; Oil, 3.10 Gal.; Gas, 434 Cu. Ft.



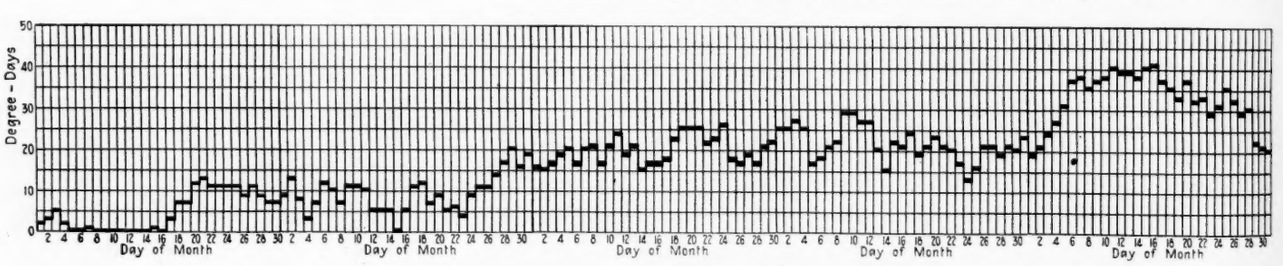
Chicago, Total Degree-Days, 6248, Amount of Fuel per Square Foot of



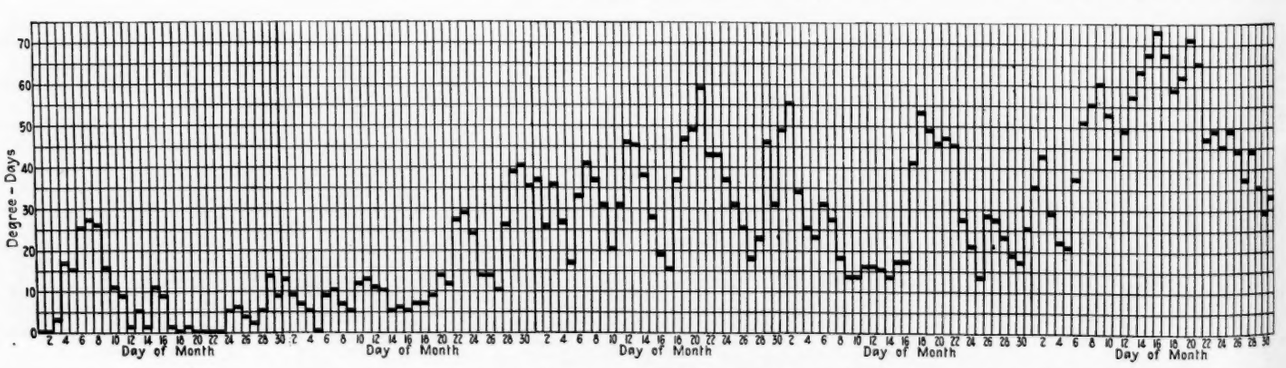
Minneapolis, Total Degree-Days, 7877, Amount of Fuel per Square Foot of



San Francisco, Total Degree-Days, 2282, Amount of Fuel per Square Foot of

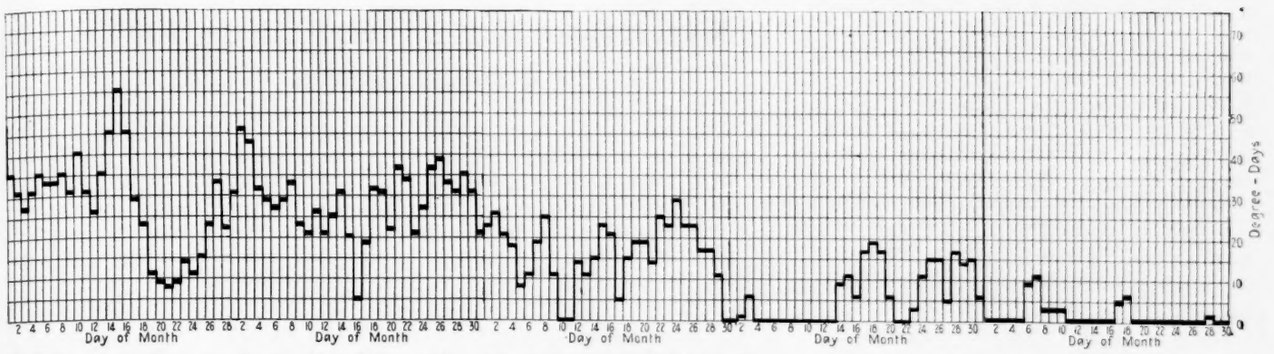


Seattle, Total Degree-Days, 4782, Amount of Fuel per Square Foof of

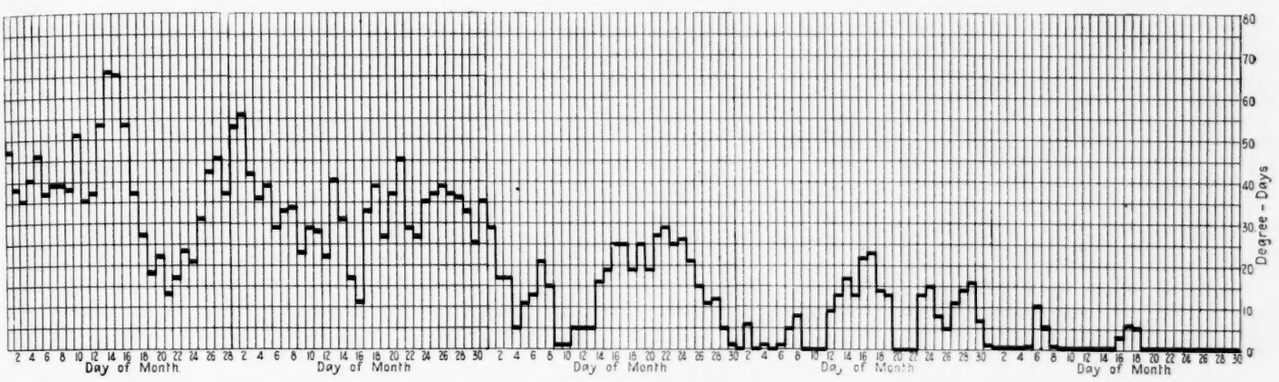


Denver, Total Degree-Days, 6171, Amount of Fuel per Square Foot of

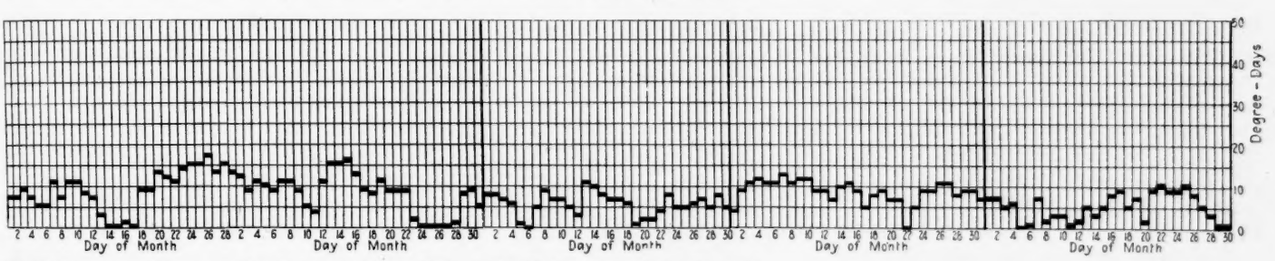
February March April May June



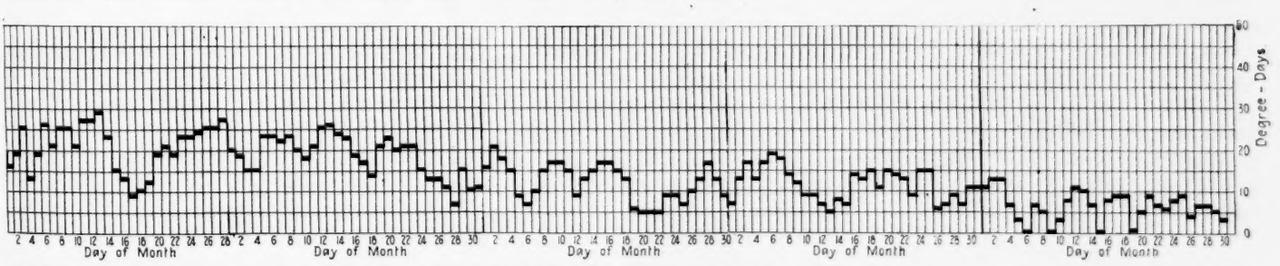
Radiation per Season: Coal, 49.9 Lbs.; Oil, 4.21 Gal.; Gas, 599 Cu. Ft.



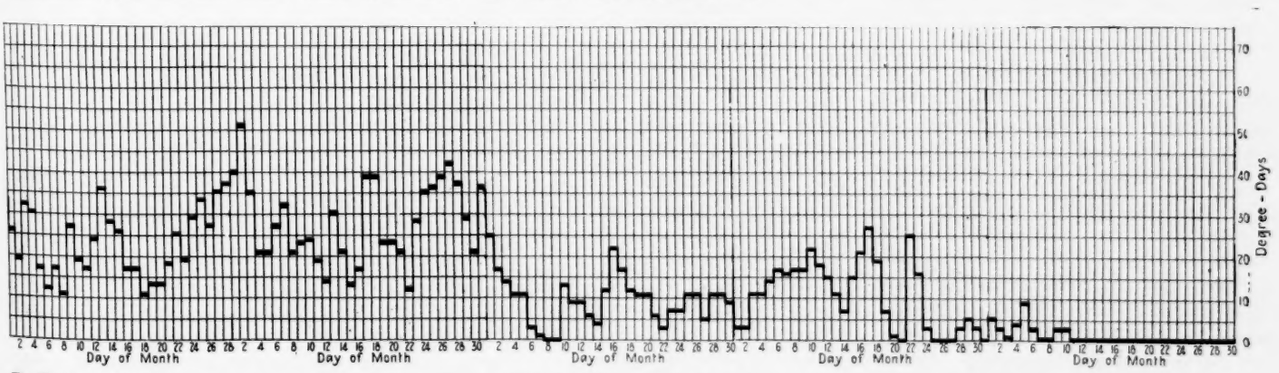
Radiation per Season: Coal, 63.0 Lbs.; Oil, 5.40 Gal.; Gas, 756 Cu. Ft.



Radiation per Season: Coal, 18.3 Lbs.; Oil, 1.56 Gal ; Gas, 219 Cu. Ft.



Radiation per Season: Coal, 38.2 Lbs.; Oil, 3.27 Gal.; Gas, 459 Cu. Ft.



Radiation per Season: Coal, 49.3 Lbs.; Oil, 4.24 Gal.; Gas, 593 Cu. Ft.

Recent Fantom Radiator Installations

Recent installations of Fantom radiators are reported by the American Radiator Company in the Chanin Building, 100,000 sq. ft.; New York Central Building, 115,000 sq. ft.; Squibb Building and Stewart Store, New York; Majestic Theatre, Dallas, Tex.; Palmolive-Peet Building, Chicago; and Northern Life Tower Building, Seattle, Wash.

As designed by Dr. Charles W. Brabbée, director of the American Radiator Company's Institute of Thermal Research, to give a higher knee-high temperature than the ordinary radiator, the Fantom usually is recessed flush with the wall beneath the window in a way to furnish direct radiation through the living area of the room between the floor and breathing-line and a warm-air curtain from the radiator to the ceiling directly above.

Following the current insistence on unobtrusive heating equipment and to maintain the maximum radiating effect, the Fantom type radiator presents an almost flat appearance. At the time Dr. Brabbée advanced his theories on the "useful" heating effect of the Fantom radiator before the A.S.H.V.E., it marked a new conception of radiator heating.

Previous to his investigations, it was assumed generally that the efficiency of a radiator depended directly on its steam consumption. His tests proved that, when a short, deep radiator is placed against the wall beside a window, most of the heat goes up immediately to the ceiling, raising the temperature as much as 30° F. at the floor line. Again, a radiator with twice as many columns, but with only half the depth and steam consumption, gave a comfortable temperature near the floor and not too high a temperature near the ceiling.

One of the interesting examples cited by Dr. Brabbée was the action of monkeys in the zoological gardens of one of our large cities, which, he stated, refused to be fooled by an unscientific heating system.

Anthracite Institute Establishes Own Laboratory

Announcement has been made by the Anthracite Coal Service that it has established its own testing laboratory. Further details will be announced later.

The announcement follows:

The growing need for a testing and developing laboratory to meet the latest requirements of the retail coal trade and the consumer has resulted in the establishment at Primos, Delaware County, Pa., of the new Anthracite Institute Laboratory which will operate under the Anthracite Coal Service.

Movement Inaugurated to Standardize Degree-Day Constants

So many requests for information concerning the degree-day unit and its application have been received by various organizations promoting its use that many interested bodies, including the American Gas Association and the American Oil Burner Association, have undertaken a study of the degree-day unit and its application. An informal meeting was held July 18, at the headquarters of the A.G.A., with Harry F. Tapp, executive secretary of the A.O.B.A., C. George Segeler, industrial editor of the A.G.A., and Clifford Strock, associate editor, HEATING AND VENTILATING, attending.

Originally developed in the gas-heating industry, the unit has been found to give remarkably accurate results for gas-fired installations in northern states. However, it does not work so satisfactorily in warm climates, especially in localities where the heating season is long and mild, such as San Francisco. Manufacturers, dealers and engineers in the oil-burner industry report that the unit fuel consumption figures which have been in use for oil are too high, and it may be that some revisions of the constants will be not only desirable but necessary.

The unit fuel consumption figures were originally developed by P. E. Fansler in the Iso-Fuel-Consumption Charts published several years ago by HEATING AND VENTILATING, and represented a definite achievement at that time. However, experience has shown that apparently some variables have not so far been considered and these variables have to be included to make the unit successful in all climates.

In order to determine the constants which should apply, it was decided that the two associations represented would endeavor to collect fuel consumption data from all parts of the country from their respective industries, and that HEATING AND VENTILATING would act as a clearing house for all figures which its readers might contribute. Readers of this publication are urged to fill in the form printed in this issue and supply data regardless of the fuel used.

Contributed data will be analyzed and later tabulated by the proper association, depending on the fuel used. In cases where the reader is unable to supply figures showing the number of degree-days each month, the various associations will endeavor to obtain this information through Weather Bureau records.

Representatives of the anthracite, bituminous and district heating industries have been invited to participate in the collection and analysis of the data. It is hoped that constants for all parts of the country can be accurately determined, based on actual experience rather than on a 100% efficiency basis. Following this it may be advisable to study the problem of applications and misapplications of the unit, so that engineers can agree as to when and when not to use the degree-day in heating calculations.

1931 Oil Burner Convention to Be Held in Philadelphia

At the meeting of the Executive Committee of the American Oil Burner Association, held at White Sulphur Springs, July 7, it was decided to hold the 1931 convention at Philadelphia, the date to be announced later.

The Committee on Uniform Ordinances reported that it is collecting and tabulating local ordinances from the principal cities in the country. The purpose of this is to bring about a change in any unreasonable laws relating to oil-burner installations. The report pointed out that many manufacturers and dealers are lax in reporting changes in amendments that are being made to ordinances and regulations throughout the country, and urged that the industry report such changes to association headquarters.

The Market Research Committee reported that the first questionnaire had been sent to manufacturer members.

A brief progress report was made by the Committee on General Trade Practices, and the committee was instructed by the board to make recommendations as to how the enforcement of the recommended trade practices could be made more effectively through the association.

It was reported by the Committee on Insurance Rates that a preliminary conference has been held with several casualty insurance companies and rating bureaus with a view to correcting the discriminatory features of various forms of insurance policies. It was indicated that the insurance companies are giving the matter serious study in striving to eliminate such features.

Oil-burner research being carried on at Yale University in cooperation with the American Society of Heating and Ventilating Engineers has been discontinued for the summer and will be resumed in the fall.

Form for Recording Degree-Day and Fuel Consumption Data

CHECK FUEL USED

COAL ☐ OIL ☐ GAS ☐ COKE ☐ ELECTRICITY ☐ DISTRICT STEAM ☐

CITY _____ STATE _____

NAME OF INDIVIDUAL OR COMPANY REPORTING _____

	NAME OR DESIGNATION OF INSTALLATION FOR PURPOSES OF IDENTIFICATION				
	1	2	3	4	5
1. FUEL CONSUMPTION BY MONTHS FOR THE SEASON					
SEPTEMBER					
OCTOBER					
NOVEMBER					
DECEMBER					
JANUARY					
FEBRUARY					
MARCH					
APRIL					
MAY					
JUNE					
TOTAL					
2. TYPE OF BUILDING (WHETHER STUCCO, BRICK VENEER, FRAME, ETC.)					
3. THEORETICAL SQUARE FEET OF RADIATION					
4. METHOD OF CALCULATING RADIATION					
5. MINIMUM OUTSIDE TEMPERATURE FOR WHICH SYSTEM WAS DESIGNED					
6. ACTUAL SQUARE FEET OF RADIATION INSTALLED					
7. B.T.U. VALUE OF FUEL					
8. TEMPERATURE MAINTAINED INSIDE DURING DAY					
9. TEMPERATURE MAINTAINED INSIDE DURING NIGHT					
10. TYPE OF HEATING SYSTEM					
11. NAME (OR MANUFACTURER'S NAME) OF BOILER					
12. BOILER NUMBER					
13. REMARKS					

ITEM 1 - ENTER THE SEASON FOR WHICH DATA ARE GIVEN AND THE FUEL CONSUMPTION BY MONTHS FOR EACH INSTALLATION. IF DISTRICT STEAM, GIVE TOTAL POUNDS OF CONDENSATE FOR MONTH.

ITEM 2 - WHETHER FRAME, STUCCO, BRICK VENEER, DETACHED OR NOT.

ITEM 3 - THEORETICAL AMOUNT OF RADIATION AS CALCULATED BY DIVIDING THE HOURLY HEAT LOSS BY 240 FOR STEAM SYSTEMS, 150 FOR WATER SYSTEMS; IF A WARM-AIR SYSTEM, CALCULATE THE THEORETICAL LEADER PIPE AREA BY THE STANDARD CODE FOR WARM-AIR FURNACES.

ITEM 4 - GIVE METHOD USED FOR CALCULATING RADIATION, WHETHER BY A.S.H.V.E. GUIDE, HEATING & PIPING CONTRACTORS NATIONAL ASSOCIATION RADIATION SHEETS, OR OTHER RULES. IF WARM-AIR FURNACE, USE STANDARD CODE.

ITEM 5 - SOMETIMES CALLED THE BASE TEMPERATURE.

ITEM 6 - ACTUAL RADIATION INSTALLED IN SQUARE FEET OF EQUIVALENT CAST IRON; IF WARM-AIR, ACTUAL SQUARE INCHES OF LEADER PIPE INSTALLED.

ITEM 7 - IN B.T.U. PER CU. FT. OF GAS, PER GAL. OF OIL OR PER LB. OF COKE OR COAL; IF DISTRICT STEAM, GIVE DIFFERENCE IN TOTAL HEAT OF ENTERING STEAM AND METERED CONDENSATE.

ITEM 8 - ESPECIALLY NOTE WHETHER TEMPERATURES HIGHER OR LOWER THAN 70° ARE MAINTAINED.

ITEM 9 - TO WHAT POINT THE THERMOSTAT IS SHIFTED BACK AT NIGHT.

ITEM 10- WHETHER STEAM, VAPOR, VACUUM, WATER OR WARM AIR.

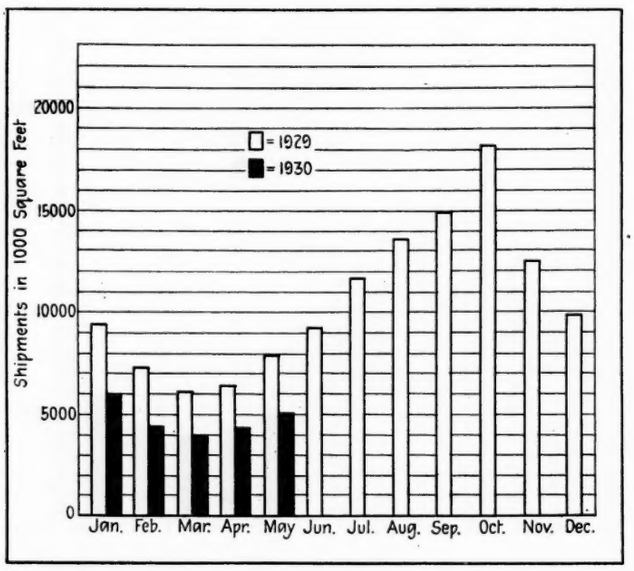
ITEM 11- IMPORTANT TO DETERMINE WHETHER CONVERTED OR SPECIALLY DESIGNED UNIT IS USED FOR THE FUEL BEING BURNED.

ITEM 13- UNDER REMARKS MENTION SUCH ITEMS AS WHETHER STOKER IS USED, WHETHER JOB IS A CONVERSION, WHETHER HOT WATER SUPPLY IS INCLUDED IN THESE FIGURES, AND OTHER PERTINENT INFORMATION.

HEATING AND VENTILATING

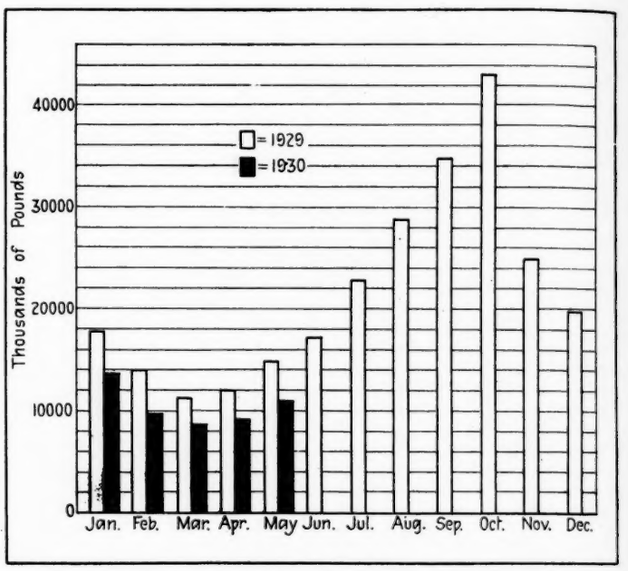
Statistical Service

Based on Data Supplied by the Department of Commerce



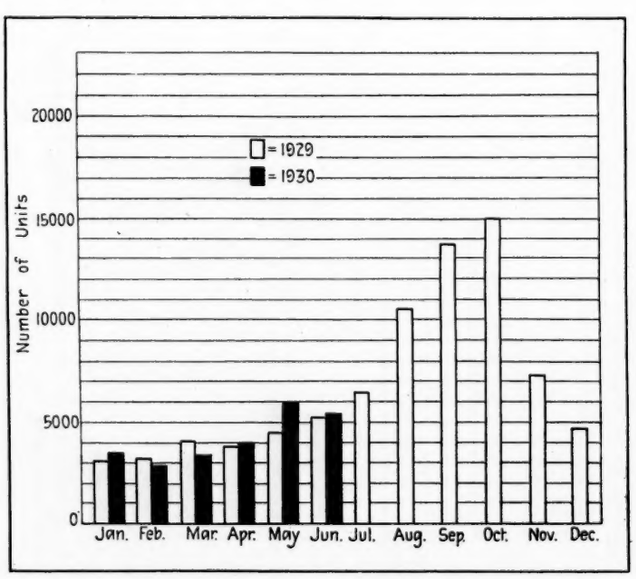
SHIPMENTS OF CAST-IRON RADIATORS
(In 1000 Square Feet)
As Reported by 15 Manufacturers Representing over 90% of the Industry

May, 1930, 5047; May, 1929, 7900; decrease over last year, 36.1%; total for five months, 1930, 23,698; for five months, 1929, 37,182; decrease over last year, 36.2%.



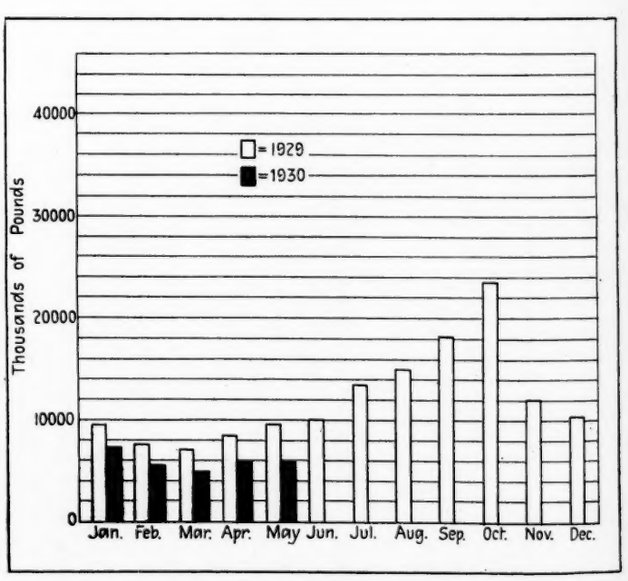
SHIPMENTS OF CAST-IRON SQUARE BOILERS
(In Thousands of Pounds)
As Reported by 25 Manufacturers Representing 90% of the Industry

May, 1930, 11,249; May, 1929, 14,946; decrease over last year, 24.7%; total for five months, 1930, 53,563; for five months, 1929, 70,843; decrease over last year, 24.4%.



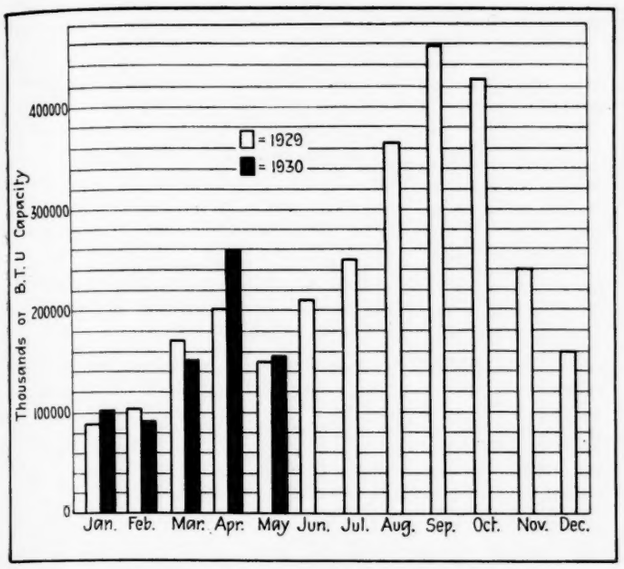
SHIPMENTS OF OIL BURNERS
(In Number of Units)
As Reported by 50 Manufacturers Representing 60% of the Industry

June, 1930, 5305; June, 1929, 5146; increase over last year, 3.1%; total for six months, 1930, 24,928; for six months, 1929, 23,810; increase over last year, 4.7%.



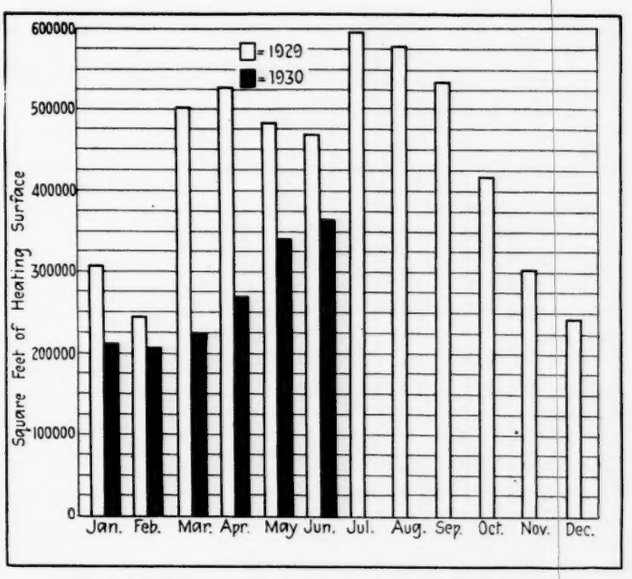
SHIPMENTS OF CAST-IRON ROUND BOILERS
(In Thousands of Pounds)
As Reported by 25 Manufacturers Representing 90% of the Industry

May, 1930, 5898; May, 1929, 9682; decrease over last year, 39.1%; total for five months, 1930, 29,506; for five months, 1929, 42,774; decrease over last year, 31.0%.



SHIPMENTS OF GAS-FIRED BOILERS
(In Thousands of B.T.U. Capacity)
As Reported by 8 Manufacturers Representing 75% of the Industry

May, 1930, 155,282; May, 1929, 149,555; increase over last year, 3.8%; total for five months, 1930, 757,778; for five months, 1929, 712,312; increase over last year, 6.4%.



NEW ORDERS FOR STEEL HEATING BOILERS
(In Square Feet of Heating Surfaces)
As Reported by Firms Making Up the Greater Part of the Industry

June, 1930, 354,723; June, 1929, 472,295; decrease over last year, 24.9%; total for six months, 1930, 1,607,912; for six months, 1929, 2,549,888; decrease over last year, 36.9%.

Death of Samuel Raisler

Samuel Raisler, president of the Raisler Heating Company and the Raisler Sprinkler Company, 129 Amsterdam Ave., New York, died suddenly of heart disease at his home, July 16. He was 55 years of age.

Born in Austria, Mr. Raisler came to New York as a young boy and was educated in the public schools. At the age of 17 he entered the employ of the American Radiator Company, serving in various capacities until 1898, when he founded the Raisler Heating Company, becoming its president. This company installs heating and ventilating appliances. In 1913, Mr. Raisler founded the Raisler Sprinkler Company, which sells and installs automatic sprinklers. At the time of his death he also was a director of the Grimes Sprinkler Company of Newark, N. J., and a director in several banks. His brother Louis, who was treasurer of the company, died about a month ago.

John T. Bradley

John T. Bradley, past president of the Heating and Piping Contractors National Association, and since 1918 sergeant-at-arms at the association's conventions, died July 13 at the age of 71. He attended the recent convention of the association in New York, and while it was noted that he had lost much of his old-time vigor, he took an active part in the work of the convention.

Mr. Bradley was widely known in the heating industry. He had not missed a meeting of the association since 1908. He was elected vice-president in 1913, and president in 1914, serving in that office for two terms.

Born in St. Louis, Mr. Bradley learned the trade of steamfitting and worked as a journeyman in St. Louis and Denver. He began his career as a heating and piping contractor in Denver, and, in 1896, organized J. T. Bradley & Company in St. Louis. In 1905, he incorporated the Bradley Heating Company which still is actively engaged in the heating business. He was prominent in banking circles and was president of the Vandeventer Trust Company for several years. His name has been connected with the heating of many large and prominent buildings, including Camp Pike at Little Rock.

John T. Bradley

A life member of the American Society of Heating and Ventilating Engineers, Mr. Bradley served on the council of the society in 1911. He is survived by his wife, two sons and five grandchildren.

New Division of Membership in A. O. B. A.

An Individual Division of the American Oil Burner Association, authorized recently for the benefit of engineers, salesmen, servicemen, and others, has been announced. An application form will be sent on request to individuals in the oil-burner industry.

With the membership in the Individual Division, a subscription to any one of three magazines, HEATING AND VENTILATING, OIL HEAT or FUEL OIL, will be given. When sending in membership applications, the choice of publications should be given and the address to which it should be forwarded.

Award for the Current Achievements in Science

In September, 1930, and each year thereafter, a gold medal and a sum of $10,000 will be awarded by *Popular Science Monthly* to the American citizen who, in the opinion of the 22 distinguished members of the Committee of Award, has been responsible for the current achievement in science of greatest potential value to the world.

Correspondence

Comments on Unit Heater Practice

EDITOR HEATING AND VENTILATING:

In the article "Showroom and Garage Heating," by Walter Timmis, which appeared in HEATING AND VENTILATING for June, several statements were made that may be easily misunderstood. In fact, it may be that I misunderstand them. Nevertheless, I would like to explain my views on several subjects he discusses.

In the fourth paragraph he says, "Unit heaters are well adapted to this type of heating but it is absolutely necessary for their successful operation, to have constant steam pressure." This is a half truth and is, therefore, dangerous.

It is true that, when the fan is running, the unit heater radiator (or convector) should always be filled with steam in order to prevent the fan from circulating air at room temperatures, which usually causes drafts, but the pressure does not need to be constant! The steam pressure in the radiator may fluctuate from a high vacuum to as high a pressure as the radiator will withstand without causing trouble from this source. As long as the steam in the radiator warms the air enough to prevent drafts, no trouble is experienced. Please do not misunderstand me. I do not advocate high steam pressures, but I do want to bring out that the steam pressure has no bearing on drafts.

Even when the steam supply is intermittent, drafts may be easily avoided by using a thermostat in series with the room thermostat and so arranged as to open the motor circuit (stopping the motor) when there is no steam in the radiator. This type of control has been in successful operation for several years.

In the fifth paragraph Mr. Timmis says, "A pressure of from 3 to 5 lbs. gauge should be carried at all times for the successful operation of the unit heater." If he means that unit heaters will not operate when the steam pressure is less than 3 to 5 lbs. gauge, I wish to call his attention to the numerous successful unit heater installations operating with steam pressures below atmospheric. If he means that unit heaters require a differential of 3 to 5 lbs. for steam circulation, I wish to call his attention to his own statement in the next to the last paragraph in which he says, "The pressure drop through the unit heater is negligible."

In spite of his own statement to the contrary, I agree that some unit heaters do require a pressure differential of 3 to 5 lbs. for adequate circulation, depending upon the size and arrangement of the steam passages. In some unit heaters the steam passages consist of a large number of very small openings that offer considerable resistance to steam flow and quickly plug up with scale, dirt and grease. A heater of this type requires a high differential when clean and an even higher one when dirty.

On the other hand, some unit heaters have one large unobstructed steam space in each section, with the result that heaters of this type require a very low differential and cannot become seriously fouled even with unusually dirty steam.

In the fifth paragraph the author states: "The pump is necessary because a pressure of from 3 to 5 lbs. gauge should be carried at all times. Under these conditions, a boiler return trap could not be used to return the water of condensation to the boiler."

Surely he does not mean what he says, because this is exactly the function of a boiler return trap. Boiler return traps are successfully used for boiler pressures as high as 15 lbs. gauge.

Possibly he means that the returns would not be high enough above the water line for a boiler return trap job. This does not seem possible, because, in general, when there is sufficient head room to properly install a good gravity system no trouble is experienced in applying a vapor system with a boiler return trap.

These comments are friendly in intent. I feel that the statements discussed above might lead to considerable misunderstanding, otherwise I would not take issue with the author.

E. H. B.

Moline, Ill.

My own experience leads me to believe that unit heaters have had their most successful application in buildings where a constant steam pressure is available. For instance laundries operating at from 50 to 75 lbs. have reduced this pressure to about 5 lbs. and have succeeded in heating very satisfactorily with unit heaters. The same thing applies to other industrial buildings, car shops, etc. On the other hand, difficulty has been experienced using unit heaters in connection with direct radiators on low-pressure systems. I have seen them installed on gravity vapor systems equipped with non-air return vent and using an oil burner. There are many occasions, in the operation of such a plant, when the steam pressure will be from 2 to 8 oz. This is sufficient, of course, to circulate steam throughout all the direct radiators, also through the radiators of the unit heaters. The rate of steam consumption in the unit heaters, however, is so rapid as to prevent the entire unit heater radiator from being filled with steam. This results in the drafty condition referred to by Mr. B.

There are also occasions when such a heating plant operates on a natural vacuum. In this case, there is, of course, no positive differential in pressure between the steam and return sides of the system and practically no steam passes through the unit heater radiator. At least, the amount of steam reaching the unit heater radiators is entirely inadequate to warm the air passing through. If some means were provided for maintaining always a constant differential in pressure between the steam and return sides of the system, whether the system is operating above atmospheric pressure or below, it is possible to operate unit heaters satisfactorily.

Referring to my statement that a boiler return trap could not be used to return the water of condensation to the boiler, this statement should have read "should not be used" instead of "could not." A boiler return trap is not designed for this purpose. It is not presumed by manufacturers that the boiler return trap will be in constant operation. The function of the boiler return trap is to act as a safety device to insure the return of water to the boiler in case the boiler pressure rises above the point where water will be returned by gravity to the boiler against the differential between the steam and return sides of the system.

Referring to Mr. B.'s fourth paragraph in which he suggests that a thermostat or pressurestat be placed in series with the room thermostat controlling the unit heater, for the purpose of preventing the unit heater from operating when there is no steam pressure, I know that this arrangement has been used, and, in fact, I have used it myself. I am not prepared to say, however, that it is entirely successful. I have found that there are many occasions when the part of the building heated by unit heaters calls for heat, while the balance of the building, particularly the space where the thermostat controlling the oil burner is located, is up to temperature. In this event, the space heated by the unit heater cannot get any heat.

W. W. TIMMIS

Hempstead, L. I.

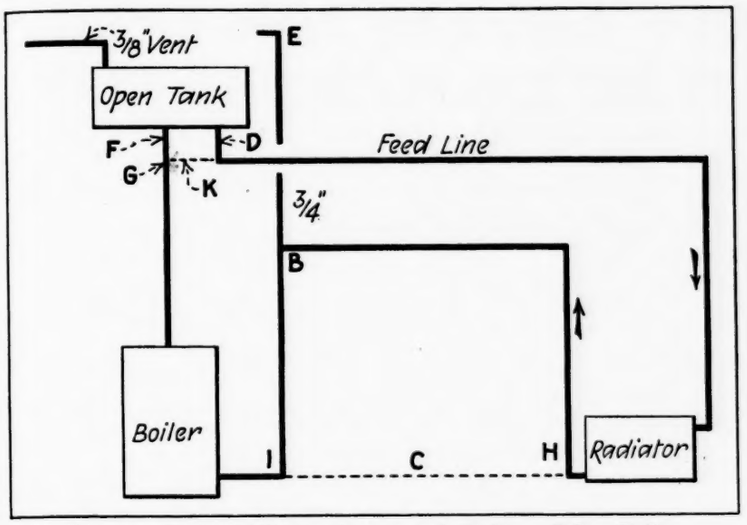


Fig. 1. Design of Water System with Radiator Below Boiler

Correcting a Hot Water System Design

EDITOR HEATING AND VENTILATING:

I enclose a rough drawing of a proposed hot water installation which has caused quite a lot of argument around this office. You will notice that I do not show any given amount of radiation or pipe sizes, etc., for the reason that the discussion was that if the pipes were properly sized in accordance with the amount of radiation installed and in accordance with the friction loss on this kind of a job, and the boiler was big enough to take care of the radiation, the job would circulate and heat properly.

The main argument was that after the system was filled and the boiler fired, the water would not circulate up the return line out of the radiator.

Will you please let me know what your opinion of this job is, and whether you figure that it will work or not? If you do not think it will work as is, please show me how you would design this job without changing the return line.

Strafford, Pa. J. J. B.

Our correspondent requests information on a water heating problem as outlined in Fig. 1. The full lines represent the original installation and the dotted lines the changes suggested.

The system as outlined eventually will circulate but very slowly. It must be remembered that hot water travels upward readily, due to its decreased weight (1 cu. ft. at 60° F. weighs 62.3 lbs., while at 180° F. it weighs 60.5 lbs.), but it will travel downward very slowly. Water will remain in the return between H and I until sufficiently cooled to circulate. The correct way is to run the return as indicated by the dotted lines at C.

If return line is not to be changed we suggest installing an elbow at G on the supply and connecting the supply as shown by dotted line K, eliminating pipe D. The vent B E will be taken out and the open expansion tank A connected to the return line at B. This also will eliminate pipe connection F to expansion tank A.

With the return line as shown and expansion tank connected to the supply riser as originally drawn, the water will evaporate from the expansion tank very rapidly, long before real circulation will take place. Expansion tank A should be connected to the return line by a pipe not greater than ¾ in.

Single and Multiple Chimneys

EDITOR HEATING AND VENTILATING:

In reply to A. W. L. in the June issue of HEATING AND VENTILATING, I must say that my argument is made with the understanding that the chimney be built right, not just thrown together.

If A. W. L. wants to bring in loose and leaking chimneys, he must build the low single chimneys loose and leaky too. Don't build poor multiple chimney flues and good single ones.

The writer repeats that he has made installations on multiple low chimneys and has had better results from them than from low single ones. These are not merely assertions that cannot be proven, but actual tests made and proven.

Why a variation in the draft of chimneys built side by side in battery the same height? If this were the case, when each one is built equally well and leakproof, then there is no assurance that we could ever figure on any chimney to any certainty. I repeat also that if the battery of chimneys is built tight (which they should be) from the foundation up, there is not the least chance of one chimney starting off ahead of the other if the combined area equals the one-fifth area of grate surface.

A. W. L.'s reference to the three chimneys, each for a separate fire in the residence he writes about has nothing in common with the case of multiple chimneys for one fire, as he says that all the joints in the flue linings were open and it was impossible to get results until new flues were built. Any chimney built in such a loose manner is a poor one.

Single chimneys are not always good tight ones and those built in multiples are not necessarily of poor construction. We have seen any number of single chimneys built so poorly that a fire was hard to start in a boiler.

Multiple low chimneys are used to avoid building a high stack for a low building, thus spoiling the appearance of the building. Multiple low chimneys are better than a single low one because of too large area for the height. For example: If a boiler had a grate area of say 11 sq. ft. this would require a chimney of 18 in. x 18 in. and on a low building would have to be built so high, about 65 ft., that it would spoil the looks of this structure. Instead we build side by side three 10 in. x 10 in. chimneys not so high. Thus we protect the appearance and get much better results from the three in multiple than the one low single chimney.

O. H. S.

Denver, Colo.

Relative Humidity with Steam and Water Systems

EDITOR HEATING AND VENTILATING:

I am interested in the statement frequently made that the relative humidity in a room is higher when heated by hot water than when heated by vapor or steam. Will you not discuss this fully in some future issue, utilizing psychrometeric tables to solve a given example.

Toronto, Ont. J. O'N.

There is no difference in the relative humidity of the two rooms, provided the dry bulb temperature indoors is maintained at the same point with either type of system. This might not be true if there is steam leaking from the radiator valve to any extent, but in a well-designed layout this will not happen.

This cannot be shown by the use of psychrometric charts, for the reason that calculations must be based on certain assumptions, and one of these must be that the dry bulb temperature is the same regardless of the type of system. This being so, we arrive at identically the same result with either hot water or steam.

Domestic Oil Burners Listed by Underwriters' Laboratories from April 11 to May 23, 1930

MANUFACTURER	MOTOR DRIVE	SAFETY CONTROL	IGNITION	FUEL FEED	MARKING	FUEL
Automatic Burner Corp., Chicago, Ill.	A.C. or D.C.	Combustion (Minneapolis-Honeywell "Type A" or "Type R-103" Protectorelay with "Type A" combustion thermostat or "Type DSS" motor switch with "Type B" combustion thermostat or Time-O-Stat "No. 77" Lockswitch with "No. 48-C" combustion thermostat for "Type E" burner. Minneapolis-Honeywell "Type U-10-C" or "Type R-103" relay with "Type B-2" combustion thermostat or Time-O-Stat "No. 77" Lockswitch with "No. 48-C" combustion thermostat for "Type H" burner.)	Gas (expanding pilot) Types E and H or gas-electric (transformer) or electric (transformer) Type E burner.	Gravity from supply tank or listed automatic pump.	Underwriters' Lab. label on burner frame; also letter "E" or "H" as suffix of pattern numbers on castings; also "Type A" or "Type R-103" on Minneapolis-Honeywell Protectorelay and "Type A" on combustion thermostat or "Type U-10-C" or "Type R-103" on Minneapolis-Honeywell relay with "Type B-2" on combustion thermostat, or "Type DSS" on Minneapolis Honeywell program motor switch with "Type B" on combustion thermostat, or "No. 77" on Time-O-Stat Lockswitch with "No. 48-C" on combustion thermostat; also "S-2" on constant level chamber.	Not heavier than No. 3.
Berggren Engineering Corp., Brooklyn, N. Y.	A.C.	Combustion (Minneapolis-Honeywell "Type R-100" or "Type R-103" Protectorelay with "Type A" combustion thermostat or "Type DSS" motor switch with "Type B" combustion thermostat, or Time-O-Stat "No. 77" Lockswitch with "No. 48-C" or "No. 48-H" combustion thermostats, or Mercoid "Type SDP" Adjustatherm with "Type M-1" combustion thermostat.)	Electric (transformer).	Suction from supply tank.	Underwriters' Lab. label on blower housing; also "Type A" or "Type B" on Minneapolis-Honeywell combustion thermostat, or "No. 48-C" or "No. 48-H" on Time-O-Stat combustion thermostat, or "Type M-1" on Mercoid combustion thermostat.	Not heavier than No. 3.
Burrell Engineering & Construction Co., Chicago, Ill.	A.C. or D.C.	Combustion (Minneapolis-Honeywell "Type BPR-1" Protectorelay with "Type A" or "Type B" combustion thermostat.)	Gas (expanding pilot).	Suction or gravity from supply tank.	Underwriters' Lab. label on side of burner base; also "Types A or B" on Minneapolis-Honeywell combustion thermostat.	Not heavier than No. 3.
Chalmers Oil Burner Co., Minneapolis, Minn.	A.C.	Combustion (Minneapolis-Honeywell "Type U-10-C" or "Type TIR-1" Protectorelay with "Type A-4" Protectostat.)	Electric (transformer).	Suction from supply tank.	Underwriters' Lab. label on blower housing; also Chalmers Type C-3 on Minneapolis-Honeywell Protectorelay.	Not heavier than No. 3.
Chisholm, Allen E., Portland, Ore.	A.C.	Combustion (Time-O-Stat "No. 77" Lockswitch with "No. 48-C" combustion thermostat).	Gas (expanding pilot).	Suction or gravity from supply tank or listed automatic pump.	Underwriters' Lab. label on burner base; also "No. 77" on Time-O-Stat Lockswitch; also "No. 48-C" on Time-O-Stat combustion thermostat.	Not heavier than No. 3.
Combustion Fuel Oil Burner Co., Milwaukee, Wis.	A.C.	Combustion (Minneapolis-Honeywell "Type A" Protectorelay with "Type A" combustion thermostat).	Gas (expanding pilot) or electric (transformer).	Suction from supply tank.	Underwriters' Lab. label on compressor base plate; also "Type D" on regulating diaphragm housing.	Not heavier than No. 4.
	A.C.	Combustion (Time-O-Stat "No. 77" Lockswitch with "No. 48-H" combustion thermostat or Minneapolis-Honeywell "Type R-103" relay with "Type A" or "Type B" combustion thermostat.)	Electric (transformer).	Suction from supply tank.	Underwriters' Lab. label on blower housing; also "No. 48-H" on Time-O-Stat combustion thermostat or "Type A" or "Type B" on Minneapolis-Honeywell combustion thermostat.	Not heavier than No. 3.
Enterprise Oil Burner Co., San Francisco, Calif.	A.C.	Combustion (Minneapolis-Honeywell "Type A" or "Type R-103" Protectorelay with "Type B" combustion thermostat or Time-O-Stat "No. 77" Lockswitch with "No. 48-C" combustion thermostat, or Mercoid "Type SDEO" Adjustatherm with "Type M-1" combustion thermostat.)	Gas (expanding pilot).	Suction from supply tank.	Underwriters' Lab. label on burner housing; also "Type A" or "Type R-103" on Minneapolis-Honeywell Protectorelay and "Type B" on combustion thermostat; or "No. 77" on Time-O-Stat Lockswitch and "No. 48-C" on combustion thermostat; or "Type SDEO" on Mercoid Adjustatherm and "Type M-1" on combustion thermostat.	Not heavier than No. 5.
Fess Oil Burners of Canada, Ltd., Toronto, Ont., Can.	A.C.	Combustion (Minneapolis-Honeywell "Type R-101" Protectorelay with "Type B" combustion thermostat or Time-O-Stat "No. 77" Lockswitch with "No. 48-H" combustion thermostat or Mercoid "Type SM" combustion thermostat.)	Electric (transformer).	Suction from supply tank.	Underwriters' Lab. label on burner housing; also "Type D-1" or "Type D-3-A" on fire-door assembly and strainer for burners "Types D-3, D-A, and D-3-A; also "Type B" on Minneapolis-Honeywell combustion thermostat, or "No. 48-H" on Time-O-Stat combustion thermostat, or "Type SM" on Mercoid combustion thermostat.	Not heavier than No. 3.
Gulf Oil Burner Co., Philadelphia, Pa.	A.C. or D.C.	Combustion (own manufacture safety relay and "Model A" combustion thermostat.)	Gas or electric (transformer).	Suction from supply tank.	Underwriters' Lab. label on burner cabinet, also "Model A" on combustion thermostat, also "Model A" or "Model B" on nozzle unit.	Not heavier than No. 3.
Home Comfort Heater Co., Philadelphia, Pa.	A.C.	Combustion (Mercoid "Type SA" combustion thermostat, or Mercoid "Type S" Adjustatherm with "Type L" combustion thermostat, or Time-O-Stat "No. 77" Lockswitch with "No. 48-C" or "No. 48-H" combustion thermostat.)	Gas.	Suction from supply tank.	Underwriters' Lab. label on main burner base; also "Type SA" or "Type L" on Mercoid combustion thermostat, or "No. 48-C" or "No. 48-H" on Time-O-Stat combustion thermostat.	Not heavier than No. 3.
International Burners Corp., New York, N. Y.	A.C. or D.C.	Combustion (Minneapolis-Honeywell "Types A, TIR, or R-103" Protectorelays with "Type A" or "Type B" combustion thermostat.)	Gas (expanding pilot) or electric (transformer).	Suction from supply tank.	Underwriters' Lab. label on blower housing; also "Type A" or "Type B" on Minneapolis-Honeywell combustion thermostat.	Not heavier than No. 3.
International Heating Co., St. Louis, Mo.	A.C.	Combustion (Minneapolis-Honeywell "Type BPR-1" Protectorelay with "Type A" combustion thermostat.)	Electric (transformer).	Suction from supply tank.	Underwriters' Lab. label on blower housing.	Not heavier than No. 3.
Malleable Iron Fittings Co., Branford, Conn.	A.C.	Combustion (Minneapolis-Honeywell "Type R-101" Protectorelay with "Type B-6" combustion thermostat or Minneapolis-Honeywell "Type U-10-C" Protectorelay with "Type A-4 or B3" combustion thermostat, or Time-O-Stat "No. 77" Lockswitch with "No. 48-H" combustion thermostat, or Penn Heat Control "Type D-1" Relay with "Type B-1" combustion thermostat).	Electric (transformer).	Suction from supply tank.	Underwriters' Lab. label on blower housing; also "Type B-6 or B-3 or A-4" on Minneapolis-Honeywell combustion thermostat, or "No. 48-H" on Time-O-Stat combustion thermostat, or "Type B-1" on Penn Heat Control combustion thermostat.	Not heavier than No. 3.
Messer Co., The, Inc., Newark, N. J.	A.C.	Combustion (Time-O-Stat "No. 77" Lockswitch with "No. 48-H" combustion thermostat, or Minneapolis-Honeywell "Type BPR-1" Protectorelay with "Type A" or "Type B" combustion thermostat.)	Electric (transformer).	Suction from supply tank.	Underwriters' Lab. label on blower housing; also "No. 77" on Time-O-Stat Lockswitch with "No. 48-H" on combustion thermostat, or "Type BPR-1" on Minneapolis-Honeywell Protectorelay with "Type A" or "Type B" on combustion thermostat.	Not heavier than No. 4.
Murray, Charles, (Braden System) Bangor, Me.	A.C.	Combustion (Mercoid "Type SDP" Adjustatherm with "Type L" or "Type M-1" combustion thermostat.)	Electric or gas-electric (transformer).	Suction from supply tank.	Underwriters' Lab. label on burner base; also "Type OB-3, OB-4, T or D-1", on strainer; also "Type L" or "Type M-1" on Mercoid combustion thermostat.	Not heavier than No. 3.
Progressive Machinery Co., Minneapolis, Minn.	A.C.	Combustion (Minneapolis-Honeywell "Type R-103" Protectorelay with "Type A" combustion thermostat or Time-O-Stat "No. 77" Lockswitch with "No. 48-H" combustion thermostat, or Mercoid "Type SDP" Adjustatherm with "Type M-1" combustion thermostat.)	Electric (transformer).	Suction from supply tank.	Underwriters' Lab. label on burner base; also "No. 48-H" on Time-O-Stat combustion thermostat, or "Type M-1" on Mercoid combustion thermostat, or "Type A" on Minneapolis-Honeywell combustion thermostat.	Not heavier than No. 3.
Remington-Keystone Mfg. Co., Ridley Park, Pa.	A.C.	Anti-flooding device (own manufacture trip valve.)	Oil pilot.	Gravity from supply tank or listed automatic pump.	Underwriters' Lab. label on blower housing.	Not heavier than No.

DOMESTIC OIL BURNERS LISTED BY UNDERWRITERS' LABORATORIES FROM APRIL 11 TO MAY 23, 1930

MANUFACTURER	MOTOR DRIVE	SAFETY CONTROL	IGNITION	FUEL FEED	MARKING	FUEL
Rickard Engineering Corp., Brooklyn, N. Y.	A.C.	Combustion (Minneapolis-Honeywell "Type DSS" program motor switch with "Type B" combustion thermostat.)	Electric (transformer).	Suction from supply tank.	Underwriters' Lab. label on burner base; also "Type B" on Minneapolis-Honeywell combustion thermostat; also "Type D" on oil strainer.	Not heavier than No. 3.
Silent Automatic Corp., Detroit, Mich.	A.C.	Combustion (Minneapolis-Honeywell "Type PRO-1" Protectorelay with "Type B" combustion thermostat, or Penn Heat "Type D-2" control with "Type A-2" combustion thermostat.)	Gas (expanding pilot) or electric (hot-wire) (Model A burner)	Gravity from supply tank or listed automatic pump.	Underwriters' Lab. label on control unit case; also Model A on burner base, or Model B on burner motor; also "S-2" on constant level chamber; also "Type B" on Minneapolis-Honeywell combustion thermostat, or "Type A-2" on Penn Heat combustion thermostat.	Not heavier than No. 2 (Model A burner), not heavier than No. 3 (Model B burner).
Tabor Mfg. Co., The, Philadelphia, Pa.	A.C.	Combustion (Minneapolis-Honeywell "Type A", "Type TIR" or "Type R-100" Protectorelay with "Type A" combustion thermostat.)	Electric (transformer).	Suction from supply tank.	Underwriters' Lab. label on burner back.	Not heavier than No. 3.
United Oil & Supply Co., Kankakee, Ill.	A.C.	Combustion (Time-O-Stat "No. 77" Lockswitch with "No. 48-C" combustion thermostat.)	Electric (transformer).	Suction from supply tank.	Underwriters' Lab. label on blower housing; also "No. 48-C" on Time-O-Stat combustion thermostat.	Not heavier than No. 3.
Wayne Tool Co., Inc., Detroit, Mich.	A.C.	Combustion (Time-O-Stat "No. 77" Lockswitch with "No. 48-C" combustion thermostat.)	Gas (expanding pilot).	Gravity from supply tank or listed automatic pump.	Underwriters' Lab. label on control stand; also "Model F" on burner unit; also "No. 48-C" on Time-O-Stat combustion thermostat.	Not heavier than No. 1.
Winslow Boiler & Engineering Co., Chicago, Ill.	A.C.	Combustion (Minneapolis-Honeywell "Type A", "Type BPR", or "Type R-103" Protectorelay with "Type A" combustion thermostat.)	Electric (transformer).	Suction from supply tank.	Underwriters' Lab. label on blower housing; also "Type A" on Minneapolis-Honeywell combustion thermostat; also "Type OB-4" on oil strainer head; also "Type OB" on flexible hose couplings.	Not heavier than No. 3.
	A.C.	Combustion (Minneapolis-Honeywell "Type A", "Type BPR", or "Type R-103" Protectorelay with "Type A" combustion thermostat.)	Electric (transformer).	Suction from supply tank.	Underwriters' Lab. label on blower housing; also "Type A" on Minneapolis-Honeywell combustion thermostat; also "Type D or T" on oil strainer head; also "Type OB" on flexible hose couplings, when used	Not heavier than No. 3.

A Testing Laboratory for Liquid Fuels

SOME idea of the extent to which manufacturers have gone in providing for the testing of their products, as well as supplementary equipment made by other manufacturers, is furnished by the testing laboratory of the Bryan Steam Corp., in Peru, Ind. Representing an investment of several thousand dollars, the laboratory is used exclusively for experimental work in connection with the burning of oil and gas. It is one of the most complete of its kind in existence. The room is 35 ft. x 60 ft. and is heated from a separate unit not shown in the illustration.

The company's experience dates back to the earliest days of the oil burner, as the company has long manufactured products in the beginning of which it had to develop a high-speed, high-powered boiler and along with it a high-speed and efficient oil burner. This experience served the company well in the design of its present boiler.

An interesting commentary is that the company has not endeavored to market the domestic burner which it developed, but has placed its experience at the disposal of oil-burner manufacturers generally.

Practically all of the accepted oil burners on the market have been tested in the company's laboratory. This was done for the purpose of determining the best methods of installation and whether the burners were capable of developing the maximum rating of the Bryan boilers. The results have been available to the different burner manufacturers without charge. In every test of a burner the company has arranged to have present a representative of the burner manufacturer.

At the head of the laboratory is E. T. Payne, chief engineer of the Bryan Steam Corporation. Associated with him is R. G. Garretson, together with assistants who have been trained in carrying out experimental work.

Testing Laboratory, Bryan Steam Corporation, Peru, Ind.

Additional Boilers, Furnaces and Radiators Approved by American Gas Association

The following house-heating appliances have passed the requirements of the American Gas Association's testing laboratory and are published in addition to the list which appeared in the March issue of HEATING AND VENTILATING. The list includes those appliances approved from February 1 to May 1. It does not include radiant heaters.

BOILERS

Hook Heater Co.,
Sharpsburg Station, Pittsburgh, Pa.

Number	*Trade Name—Hook*	Output Rating Sq. Ft. Steam Radiation	Sq. Ft. Water Radiation
1514		2,140	3,430
1615		2,300	3,680
1716		2,450	3,930
1817		2,610	4,170

Peerless Heater Company, Boyertown, Pa.
Trade Name—Peerless

5S3, 5W3	580	950
6S3, 6W3	700	1,120
6S5, 6W5	2,080	3,330
7S5, 7W5	2,410	3,880
8S5, 8W5	2,770	4,440
9S5, 9W5	3,110	5,000
10S5, 10W5	3,470	5,660
11S5, 11W5	3,820	6,110
12S5, 12W5	4,170	6,660
13S5, 13W5	4,510	7,240
14S5, 14W5	4,860	7,780
15S5, 15W5	5,200	8,330
16S5, 16W5	5,550	8,890
17S5, 17W5	5,890	9,430
18S5, 18W5	6,240	10,000
19S5, 19W5	6,590	10,550
20S5, 20W5	6,940	11,100
21S5, 21W5	7,280	11,640
22S5, 22W5	7,630	12,210

FURNACES

Foss Heating & Sheet Metal Co.,
21 S. Chester St., Pasadena, Cal.

Trade Name—Holly (with blower)	Input Rating B.T.U. per hr.
A-22	450,000
A-23	675,000
A-24	900,000
A-25	1,125,000
A-26	1,350,000

Fraser Furnace Co., Inc.,
445 S. San Joaquin St., Stockton, Cal.
Trade Name—Fraser

30	27,500
40	55,000
50	82,500
60	110,000
70	137,500
80	165,000
90	192,000
100	220,000

Lennox Furnace Co., Marshalltown, Iowa
Trade Name—Torridzone

1	60,000

Miller Furnace Co.,
2165 39th Ave., Oakland, Cal.
Trade Name—Miller

4	18,425

Pacific Gas Radiator Co.,
7541 Roseberry St., Huntington Park, Cal.
Trade Name—Pacific (with blower)

*6	200,000
*8	290,000
*10	380,000

Pennsylvania Furnace & Iron Co.,
318 Pine St., Warren, Pa.
Trade Name—Pennsylvania

*16	90,000
*20	120,000
*24	150,000
*28	180,000
*32	210,000
*36	240,000
*40	270,000

CIRCULATORS

Advance Stove Works, Evansville, Ind.
Trade Name—Flasheat

	Input Rating B.T.U. per hr.
*8830	36,000

Allen Mfg. Co.,
10th & Union Sts., Nashville, Tenn.
Trade Name—Allen's Parlow Furnace

800M	47,500

American Gas Products Corp.,
Chrysler Bldg., New York, N. Y.
Trade Name—Unitor

**1	16,800
2	21,600
3	26,400

Cleveland Cooperative Stove Co.,
2323 E. 67th St., Cleveland, O.
Trade Name—Grand

141	35,000

Gem City Stove & Mfg. Co., Quincy, Ill.
Trade Name—Thermolator

G-1	40,000

Odin Stove Mfg. Co.,
302 W. 12th St., Erie, Pa.
Trade Name—Odin

*715	15,000

Quality Stove & Range Co.,
Div. of Oakland Foundry Co., Belleville, Ill.
Trade Name—Quality

95N	25,000

GAS-FIRED STEAM RADIATORS

James B. Clow & Sons,
201 N. Talman Ave., Chicago, Ill.
Trade Name—Clow

*4 Tube 5 Sec.	7,700
*4 Tube 7 Sec.	10,500
*4 Tube 9 Sec.	13,500
*4 Tube 11 Sec.	16,500
*4 Tube 13 Sec.	19,500
*4 Tube 15 Sec.	22,500
*4 Tube 20 Sec.	30,000
*4 Tube 25 Sec.	34,000

Pacific Gas Radiator Co.,
7541 Roseberry St., Huntington Park, Calif.
Trade Name—Pacific

5 Col. 5 Sec. 38" Vented	10,000

*Changed.
**Listed Prior to May 1.

Consolidated Gas Reduces House-Heating Rates

Because of the increased use of gas for residential heating purposes the Consolidated Gas Company of New York has announced that it has filed with the Public Service Commission a new schedule of rates proposing a 20% reduction in the charge for gas intended for such use. If the approval of the commission is obtained the new schedule, applying only to consumers whose heating requirements are at least 60% of their total annual gas consumption, will go into effect on August 1.

The reduction, which is the third effected by the Consolidated Gas Company and its affiliated companies since 1927, would affect only the straight charge as measured by the measure, the radiation charge for heating purposes and the so-called flat rate for general purposes remaining at their present level.

The actual reduction proposed is in part two of the new schedule, under which the present rate of 7½ cents per 100 cu. ft. would be reduced to 6 cents for the same amount of gas consumed.

As under its previous reductions, the new rates would be optional for customers using the required amount of gas for heating purposes, each customer having the privilege of choosing either the flat rate of $1.15 per 1000 for the first 100,000 cu. ft. of gas a month, with reductions for each additional 100,000 cu. ft. used, or the new rate.

Heating Contracts Necessitate Expansion by Memphis Gas

The capacity of the Guthrie, La., compressor station of Memphis Natural Gas Company is to be increased by approximately 20%, according to an announcement by D. C. Schaffer, general superintendent. The increased capacity is made necessary as the result of new heating contracts effective this coming winter. Contracts for the necessary work are now being let, so that it will be completed well in advance of the next heating season. The Guthrie station, one of two compressor stations maintained by Memphis Natural Gas Company, is located at the Monroe field end of the company's 210-mile high-pressure pipe line, which terminates in Memphis, Tenn. The other station is located near Benoit, Miss.

Flow of Air Through Orifices

Bulletin 207 of the Engineering Experiment Station of the University of Illinois, "The Flow of Air Through Circular Orifices with Rounded Approach," gives the results of a study of the flow of air to determine coefficients to be applied to Fliegner's formula.

In the investigation ordinary atmospheric air was compressed and stored in a weighing tank with no particular attempt to remove the moisture or control the humidity. The pressures on the inlet side of the orifice were varied from 1 in. of water to 35 in. of mercury.

The authors of the bulletin are Joseph A. Polson, Joseph G. Lowther and Benjamin J. Wilson. Size 6 in. x 9 in. Copies may be obtained free from the Engineering Experiment Station, Urbana, Ill.

A Climate Factory

A "CLIMATE FACTORY," in which it is possible to reproduce at will almost any conditions that may be desired in a wide range of temperature and other factors, is in operation at Johns Hopkins University in Baltimore. It is under the direction of H. W. Howell, professor of physiology at the Johns Hopkins School of Hygiene and Public Health.

In a story on the "Climate Factory," which appeared in *Tycos-Rochester*, an account is given of the experiments conducted to learn something of the effect of climate on the human body's capacity for sustained comfort. In one test, where the experimenter held out his arm horizontally, it was found that in a warm room, with humid atmosphere, the limit of endurance for the outstretched arm is materially less than under conditions of bodily comfort. The atmosphere of a muggy day in August will show a loss of possibly one-half compared with the results obtainable on a bracing day in April or October.

This simple truth is one of the elements in a study of climatic influence made in the laboratories of the Johns Hopkins University at Baltimore. In their research the investigators employed a highly scientific "climate factory," enabling them to reproduce at will almost any conditions that may be desired in a wide range of temperature and other factors.

As Dr. Howell expressed it, "When a person is confined within the experimental chamber there is significance in his ability to hold his arm extended. At a temperature of, say, 70° F., and with relative humidity of 50%, the powers of endurance are considerable. Subject the same person to a temperature of 95°, and relative humidity of 100%, and he suffers a loss of perhaps 50% of his staying quality."

Along the lines mapped out for this research there is rich field for investigation. Close attention will be given an attempt to determine the extent to which abnormal weather and climate may impair bodily resistance to disease. There will also be a search for data bearing on the health of operatives in laundries and textile mills, where they are exposed to high temperatures and heavy humidity. Experience and observation have brought conviction that the workers in such industries are more than normally susceptible to infection from tuberculosis.

The "climate factory" at Johns Hopkins provides accurate regulation for indefinite periods. Air for use in the tests is taken from outdoors and passed through an air-conditioning chamber containing cooling and heating coils, fans and water-sprays. In its passage through the ducts and channels the air receives treatment for temperature and humidity, until it leaves the room as an accurate sample of the climate that is desired.

Temperature and Humidity Can Be Controlled

Moisture of the air is regulated by subjection of the current to sprays of water. Taken from the outside, for instance, at a temperature of 55° F., and with relative humidity of 47%, the air passes through sprayed water of a higher temperature. The contact causes the air to gain augmented absorptive power, and produces increased humidity. If lowered moisture is desired, the air is subjected to a cold spray which brings diminished carrying capacity and therefore produces air that is dryer and more bracing.

The chamber is air-tight, aside from carefully-controlled ventilating apparatus which regulates purity without changing the character of the atmosphere. A doorway fitted with a refrigerator door with beveled and padded edges provides the sole means of entrance and exit.

Device for Measuring Balance of Eye Muscles as Influenced by Exertion Under Different Climatic Conditions

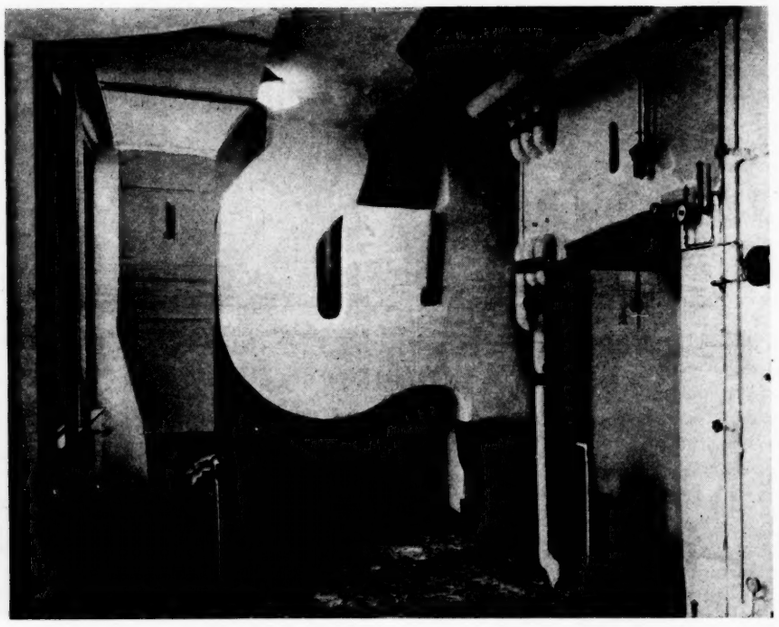
Within this chamber the subject is exposed to various climates, with a view to a study of his or her physical reactions. The manifestations observed by the scientists include the pulse rate, the bodily temperature, the blood pressure, and the influence of atmospheric and weather conditions on sight and hearing.

Muscular control is another phase of the study. An instrument is employed to determine the steadiness of the human muscles in operations requiring fineness of touch, under the influence of varying temperatures and moistures. Effect on the steadiness of vision is studied by means of a phorometer. Mental effort is investigated by observation of fatigue experienced by a subject who has been given difficult tasks such as complicated sums in mathematics.

Experiments conducted by the United States Bureau of Mines show that sharp rise in bodily temperature is produced by exposure to hot air of high humidity. At 95° F., with 100% of relative humidity, a typical subject shows an increase of 1.4° in the temperature of the body; at 96° the rise is 2.3°, and at 100 it reaches 3.4°.

Strangely enough, the investigators have become convinced that it is not the bodily temperature that causes the chief discomfort on a hot, steaming day in August. The real factor of suffering is the pulse. At 96° the pulse rate of a subject which started at 104 has advanced to 158. At 100° the rate reaches 180. The tests show that at 135 pulsa-

Device for Measuring Muscle Fatigue and Varying Temperatures and Humidities



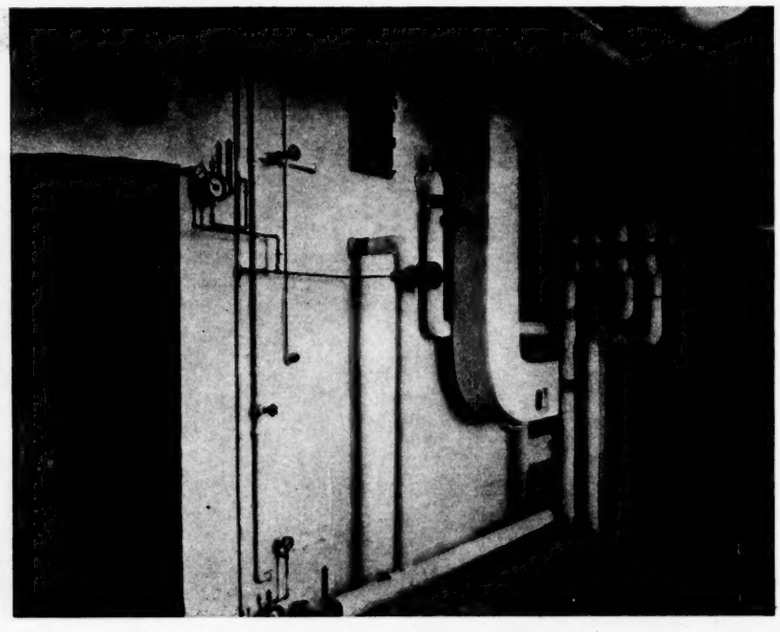
View of "Climate Factory," Showing Arrangement of Fans, Ducts, Heating Coils and Control Equipment

tions to the minute the subject experiences definite discomfort, and that at 160 the conditions become so severe as to cause a demand for a chance to return to the open air. At the high pulsations the subject becomes weak and dizzy, with a "dragged-out" feeling that persists for an hour after his release from the test chamber.

A strange revelation brought forth by the research is that there is a border line at which a moving fan ceases to provide comfort and becomes a positive disadvantage. At 95° and 96° of temperature, with high humidity, the operation of a fan was helpful. At 100° the conditions were worse with the fan than without it, as shown by the fact that all the subjects were able to spend 60 min. in the test chamber when the fan was not operated, but that none of them could stay for the full hour with the fan in motion.

High temperatures and high moisture produce increased blood pressure, as recorded by a sphygmomanometer. The investigators feel that the rise in blood pressure doubtless contributes to the discomfort of a hot day. The symptoms noted by the observers were palpitation of the heart, dizziness, soreness of the face, and a condition of nausea.

The tests tend to contradict the old belief that ice water is a menace to the worker in overheated surroundings. Throughout the entire series of experiments there was no development of "cramps" or discomfort through the free drinking of cold water.



Spray Chamber in "Climate Factory"

Air is taken from outdoors through the intake shown at right. A glass window in the upper center enables the operator to observe the interior of the spray chamber.

Bulletins on Certified Heating and Time-Payment Selling

"How to Sell Certified Heating" and "Time-Payment Selling" are discussed in the June and July, 1930, issues, respectively, of the Plumbing and Heating Industries Bulletin, published by the Plumbing and Heating Industries Bureau.

The story on "How to Sell Certified Heating" is based upon the experiences of representative heating contractors including R. B. Miller, New York; E. W. Mandeville, New York; Robert Purvis, Sr., Brooklyn; Charles Schneider, New York; Robert Purvis, Jr., New York; Bruce Wigle, Detroit, and Walter Klie, Cleveland.

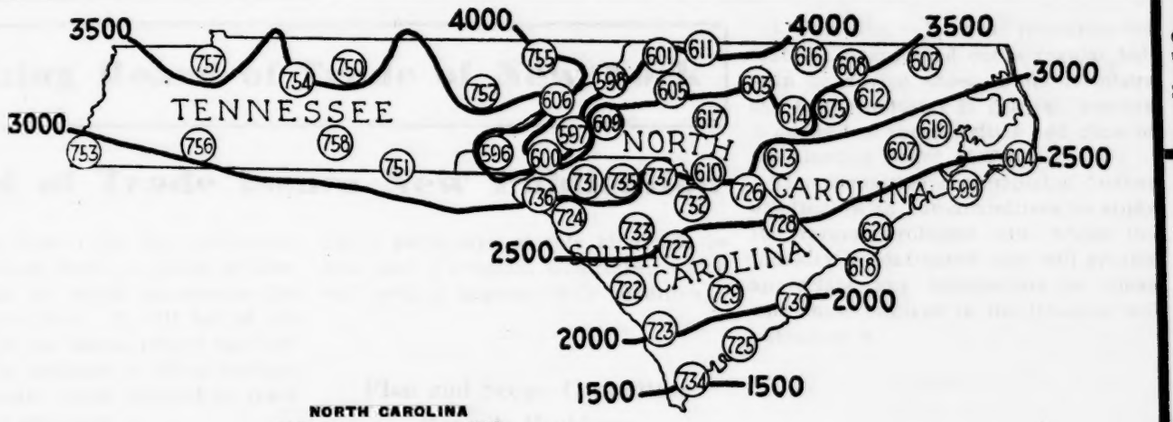
Several typical sales talks are included showing recommended methods of approach in interesting the homeowner in Certified Heating.

Among the topics given special emphasis are the three types of modernizing prospects, including those who are able and willing to buy, constituting about 50% of the market, those who are able pay cash but who are unwilling to do so, constituting 20% of the market, and those who have no savings from which to pay for improvements and who, therefore, must pay from income, constituting about 30% of the market.

$132,000,000 Federal Building Plan is Assured

The Federal building program of $132,000,000 for this year is assured, as stated by Andrew W. Mellon, Secretary of the Treasury, in reporting progress through the first half of the year and in promising that the program will be expedited to the fullest possible extent in line with President Hoover's announced policy regarding unemployment.

Mr. Mellon further stated that since January 1 construction amounting to $28,000,000 has been undertaken in addition to the $40,000,000 already under contract at the beginning of the year. Contracts now are being let which involve $70,000,000 for monumental buildings, and of this amount at least $30,000,000 is to be expended this year.



No. 5-Q New Series

ISO-DEGREE DAY CHARTS—Tennessee, North Carolina and South Carolina

TENNESSEE

750	Carthage	3648
751	Chattanooga	3118
752	Knoxville	3670
753	Memphis	2950
754	Nashville	3578
755	Rogersville	4051
756	Savannah	3199
757	Springville	3653
758	Tullahoma	3794

NORTH CAROLINA

596	Andrews	3902
597	Asheville	4263
598	Banners Elk	5747
599	Beaufort	2308
600	Brevard	4180
601	Brewers	3910
602	Eagletown	3347
603	Greensboro	3527
604	Hatteras	2571
605	Hickory	3111
606	Hot Springs	3487
607	Kinston	2767
608	Louisburg	3516
609	Marion	3597
610	Monroe	3152
611	Mt. Airy	4128
612	Nashville	3219
613	Pinehurst	2818
614	Pittsboro	3618
615	Raleigh	3234
616	Roxboro	3836
617	Salisbury	3221
618	Southport	2199
619	Washington	2672
620	Wilmington	2302
	Winston-Salem	3878

SOUTH CAROLINA

722	Aiken	2311
723	Allendale	2156
724	Anderson	2732
725	Charleston	1769
726	Cheraw	2816
727	Columbia	2364
728	Dillon	2500
729	Ferguson	2245
730	Georgetown	2027
731	Greenville	3452
732	Health Spring	2963
733	Newberry	2649
734	Parry Island	1601
735	Spartanburg	3257
736	Walhalla	3191
737	York	2725

UTAH

799	Black Rock	6432
800	Blanding	5867
801	Cedar City	5679
802	East Portal	11128
803	Emery	7020
804	Escalante	6193
805	Green River	5967
806	Ibopah	7569
807	Kelton	6690
808	Levan	6886
809	Logan	6735
810	Manila	8452
	Ogden	5537
811	St. George	3758
812	Salt Lake City	5553

ARIZONA

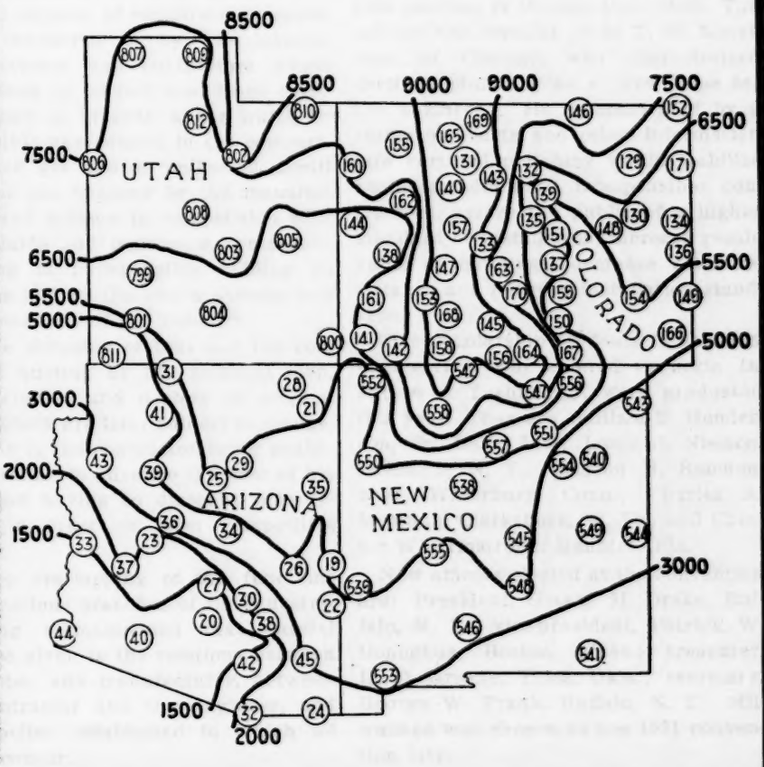
19	Alpine Ranger Sta.	7863
20	Casa Grande	1283
21	Chin Lee	5908
22	Clifton	2182
23	Congress	1688
24	Douglass	2628
25	Flagstaff	7135
26	Fort Apache	4925
27	Granite Reef Dam	1418
28	Kayenta	5317
29	Leupp	5311
30	Miami	2418
31	Moccasin	5324
32	Nogales	2513
33	Parker	1498
34	Payson	4496
	Phoenix	1404
35	Pinto	5422
36	Prescott Dry Farm	4499
37	Salome	2144
38	San Carlos	2258
39	Seligman	5004
40	Sentinel	1154
41	Supai	2722
42	Tucson	1845
43	Truxton	3375
44	Yuma	918
45	Willcox	3325

COLORADO

129	Akron	6723
130	Arriba	6393
131	Blue Valley Ranch	9759
132	Boulder	5523
133	Buena Vista	8849
134	Burlington	5903
135	Cheesman	6907
136	Cheyenne Wells	6336
137	Colorado Springs	6519
138	Delta	6065
139	Denver	5873
140	Dillon	11516
141	Dolores	6824
142	Fort Lewis	7645
143	Fraser	12022
144	Fruita	6205
145	Garnett	8633
	Grand Junction	5676
146	Grover	7641
147	Gunnison	10224
148	Hamps	6969
149	Holly	5169
150	Huerfano	6157
151	Husted	6741
152	Julesburg	6752
153	Lake City	9331
154	Las Animas	5598
155	Lay	8337
	Leadville	10944
156	Manassa	8295
157	Nast	10481
158	Pagosa Springs	8532
159	Pueblo	5514
160	Rangely	7888
161	Redvale	7057
162	Rifle	6643
163	Salida	7166
164	San Louis	8227
165	Steamboat Springs	9628
166	Two Buttes	5163
167	Trinidad	5328
168	Wagon Wheel Gap	10834
169	Walden	9918
170	Westcliffe	8170
171	Wray	5673

NEW MEXICO

538	Albuquerque	4303
539	Aragon	6160
540	Campana	4282
541	Carlsbad	2589
542	Chama	7945
543	Clayton	4831
544	Clovis	4195
545	Corona	5113
546	Elephant Butte	3400
547	Elizabethtown	9455
548	Fort Stanton	5066
549	Fort Sumner	3913
550	Fort Wingate	5640
551	Fort Union	6229
552	Fruitland	5537
553	Gage	3251
554	Gallinas Springs	4552
555	Magdalena	4938
556	Raton	5947
557	Sante Fe	6063
558	Senorito	8930



No. 5-P New Series

ISO-DEGREE-DAY CHARTS—Utah, Arizona, Colorado and New Mexico

Heating and Ventilating's Data Sheets Nos. 5-P and 5-Q

Heating Board of Trade of New York

Board of Trade Issues New Publication

"Heating News," the new publication of the Heating Board of Trade of New York, made its initial appearance the last week in June. It will tell of the activities of the board, inform the public as to its methods of doing business and the means being pursued to reach the desired objective.

Several items from the June issue of the publication follow:

Fan and Unit Heater Manufacturers Meet

At the request of several manufacturers of fans, blowers and unit heaters, an informal meeting was held to which was invited the representative concerns of this vicinity. A very high-minded group answered this call and the outcome was a desire for a subsequent and larger meeting. This was held, and C. E. Lawrence selected as chairman, with Messrs. Hedges and Munder named to act with the chairman in presenting a program at a third meeting to be held later.

It is the belief of those within this group that if they can become personally better acquainted that they will be reliably informed as to competitive methods of doing business, counsel together as to ironing out misunderstandings among themselves, and where concord of action with other groups is essential that means can be found to accomplish this. They are enthusiastic in the belief that a simple organization such as this will do much for them.

Boiler Setting Requires Skilled Craftsmen

A highly-specialized branch of the heating industry is that of boiler setting. In a city the size of New York with congested conditions necessitated by modern day construction, together with the variegated boiler conditions, the art of enclosing boilers has reached a point where unusual experience and ingenuity are required.

The boiler setters of the vicinity recognize the difficulties of their business, and contemplate a group under the auspices of the Heating Board of Trade of New York. Frederick Page was elected chairman of this group, at a meeting held in the quarters of the Heating Board of Trade of New York, June 18, and it is expected that frequent gatherings of this kind will be held, and a program undertaken which will seek to improve their condition.

Plan and Scope Committee Reports Problems

President Nygren at a meeting of the Board of Governors, called on May 22, 1930, appointed a Plan and Scope Committee, composed of Messrs. Bennett, Berman, Eadie, Erskine, Keating, Keasbey and Wolff, for the purpose of studying conditions and abuses prevalent in the industry and in making recommendations to the board as to what problems should first be undertaken.

At a meeting of the board of governors held June 12, the chairman reported that the committee had held three meetings at which they had carefully gone over the very valuable material which had been sent to the secretary by the various members voluntarily in reply to the questionnaire submitted to the membership. The committee reported that the problems apparently demanding the most immediate attention were as follows:

1. It was recommended that the matter of credits be given thorough study with the purpose of establishing a credit policy concurred in by the jobbers, manufacturers and contractors which would tend to correct conditions existing largely at present, under which irresponsible new-comers in the contracting game get almost unlimited credit and thus are financed by the manufacturers and jobbers in competition with the reliable and legitimate contractor, resulting in irresponsible bidding on the jobs and in the end a serious loss to all branches of the industry.

2. The shopping of bids and the consequent quoting by the material men, manufacturers and dealers of original prices which are later subject to change, resulting in the contractor being unable to determine in advance the cost of his work and having to discount bids received in order to meet competitive bidding.

3. The overlapping of the functions of the various branches of the industry, it being recommended that careful study be given to the relations between the jobber and manufacturer, between the contractor and the engineer, and some policy established in which all would concur.

4. Publicity. — It was recommended that the board send out a regular bulletin or advice sheet to its members and to the industry in general, keeping it advised of the activities and aims of the Heating Board of Trade.

The committee contemplates further meetings with sub-committees to study the various problems with which the industry is confronted, and will greatly appreciate any suggestions or ideas that those engaged in the industry will submit to it.

Standing Committees

The standing committees of the Heating Board of Trade of New York are as follows:

Executive Committee — Werner Nygren, R. A. Wolff, C. E. Lawrence, A. P. Keasbey, P. R. Mork, B. W. Bennett, A. R. Jaros, Jr., J. J. Ney.

Finance Committee — J. G. Eadie, R. H. Carpenter, P. R. Mork.

Membership Committee—S. C. Carrier, L. K. Berman, M. M. Goldsmith, A. P. Keasbey, C. R. Place.

Master Plumbers' Association Advocates Certified Plumbing

Certified plumbing, along the line adopted by the heating industry for certified heating, was proposed as a leading activity of the National Association of Master Plumbers at its annual meeting in Boston, June 23-26. The subject was brought up by T. W. Merriman, of Chicago, who characterized certified plumbing as a "new hope for the business." He demonstrated by a series of charts and other information how certified plumbing would stabilize business, eliminate irresponsible contractors, assure the public of a higher standard of installation, increase resale value of buildings, decrease sales resistance and improve installation standards.

Five scholarship students in sanitary engineering, who entered Carnegie Institute of Technology, were graduated this year. They are William F. Henderson, Jr., Gary, Ind.; Louis S. Nielson, Brooklyn, N. Y.; Clayton H. Reichenbach, Waterbury, Conn.; Charles A. McMunn, Clarksburg, W. Va., and Chester W. Armstrong, Manatee, Fla.

New officers elected at the convention are: President, George H. Drake, Buffalo, N. Y.; vice-president, Patrick W. Donoghue, Boston, Mass.; treasurer, H. O. Greene, Tulsa, Okla.; secretary, George W. Frank, Buffalo, N. Y. Milwaukee was chosen as the 1931 convention city.

New Apparatus and Appliances

Doherty-Brehm Humidifying Unit

Designed for the average six to ten-room house, the Model A humidifier has been announced by the Doherty-Brehm Co., Minneapolis, Minn. The device is constructed as a radiator heating unit, and replaces any cast-iron radiator in smaller types of homes. In large homes the Model B or C central humidifying system can be installed.

The cabinet enclosing the Model A humidifier is removable, and is constructed of furniture steel. It can be furnished in tones to match the furniture or woodwork and in various sizes to conform to space requirements.

Sections of the humidifier are hollow and act as heating units. The heating medium, hot water, steam or vapor, flow through the hollow part of each radiator section. The humidifier as a whole is connected to the house-heating system in the same manner as an ordinary radiator. Each radiator section being hot, stimulates the evaporation of the water in the trough on the top of each radiator section, the water being left in ¼ in. deep. The shallow depth of the water over the heated area greatly stimulates evaporation. The colder the outside air with the consequent increased demand for heat and moisture indoors, the hotter the radiator and consequently the more evaporation.

Humidification is controlled by means of a float valve made of brass so that it will not rust or clog or corrode.

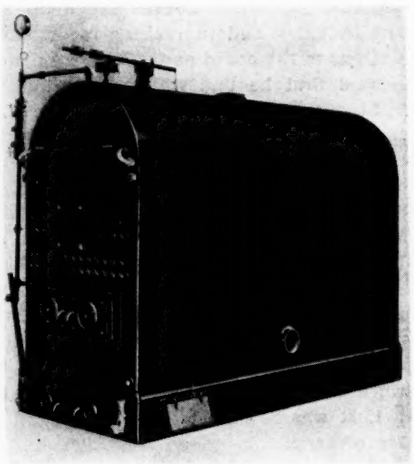
Horizontal sections are made of nickel alloy iron setting in a copper floor pan with an outlet to the sewer. A city water line runs to a float valve tank.

The float valve feeds from 2 to 3 gals. of cold city water every hour into the top horizontal radiator section. As soon as the trough is filled the water is spilled over to a down-spout onto the horizontal radiator section below it. This process is continued until the tops of all horizontal radiator sections are covered with water.

Doherty-Brehm Model A Humidifier

Bass Steel Heating Boilers

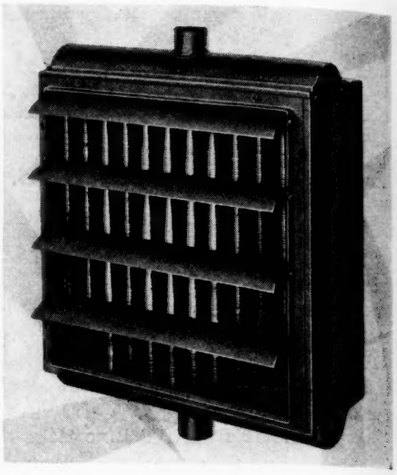
An electrically welded steel heating boiler for steam, vapor or hot water systems has been announced by the Bass Foundry and Machine Co., Fort Wayne, Ind. Of portable type, the boiler is of water tube design. It is adaptable to coal firing (by hand or stoker), oil or gas firing, and is constructed with two fireboxes, one at the front and the other at the rear of the boiler. When the boiler is coal fired, incinerator grates for the disposal of wet garbage may be installed in the rear firebox. When the boiler is oil fired, garbage may be burned on the coal grates installed in the front firebox.



Bass Steel Heating Boiler

When oil fired, the burner is applied to the rear firebox of the boiler and the baffling arranged to give four passes of the products of combustion over the tubes, thus obtaining low stack temperatures. With this method of oil-burner installation, should the oil burner be out of commission, a coal fire may be kindled on the coal grates in the front fire box without any change or readjustment of equipment.

The boilers are equipped with domestic hot water heating coils built integral with the boiler unit, and are built in a range of 25 sizes from 700 sq. ft. to 25,000 sq. ft. of steam radiation.



Skinner Bros. Type LW Unit Heater

Skinner Type LW Unit Heater

Skinner Brothers Mfg. Co., Inc., 1474 So. Vandeventer, St. Louis, Mo., has announced the type LW unit heater, composed of a bank of extended surface radiation through which air is forced by a propeller type fan. The coil is built of a bank of ¾-in. steel pipe, the extended surface on which consists of cold-rolled steel fins pressed on so that each fin is held in place by a spring set. If so desired coils of copper tubing can be supplied.

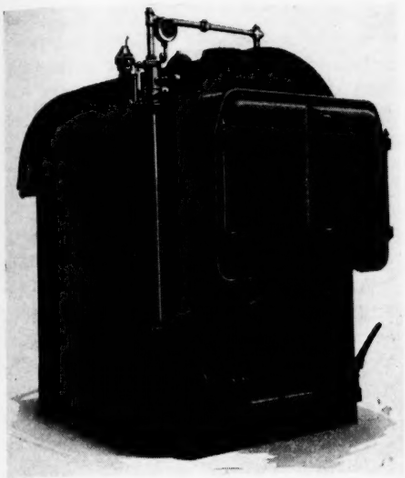
Pitch of the fan blade varies with the radius in such a way as to result in a uniform velocity through the wheel. Louvres are so designed that they may be adjusted to any desired position in either the horizontal or the vertical plane. Type LW Unit Heaters are available in six sizes with capacities ranging from 37,800 to 246,200 B.T.U. per hr. at a steam pressure of 2 lbs.

General Humidifier for Furnaces

A humidifier for warm-air furnaces is being manufactured by the General Gas Furnace Co., Inc., 1326 Hudson Ave., Rochester, N. Y. In this device the water for humidification is sprayed into the warmed air as it passes through the furnace. The unit has a capacity of 16 gal. of water per day at 60 lbs. water pressure.

Evaporation is increased or decreased by opening or closing the covers over the spray. Surplus water is carried to the sewer. All parts in contact with the water are made of brass or aluminum.

The unit is installed by cutting a whole in the furnace casing and in the radiation shield opposite the fire pot and under the radiator just above or below the middle casing ring, and the water line connected.



Titusville Series SR Boiler

Titusville Compact Type SR Boiler

Of all steel construction and limited bulk, the type SR Titusville compact boiler is made of single sheets double electric welded with no longitudinal seams in the shell. It is of the three-pass type, with a rounded top furnace. The name is derived from the fact that it has a large volume of combustion space and a large amount of heating surface.

The bituminous coal type differs from the anthracite-burning model in the size of the tubes and in the fact that the bituminous coal type has a baffle mounted on water tube headers in the rear of the combustion chamber, so as to insure complete combustion. The oil-burning type is changeable from oil to coal, as desired, by installing grates.

Three-inch tubes are used for anthracite, oil and gas-fired type, and 3½-in. tubes for bituminous coal.

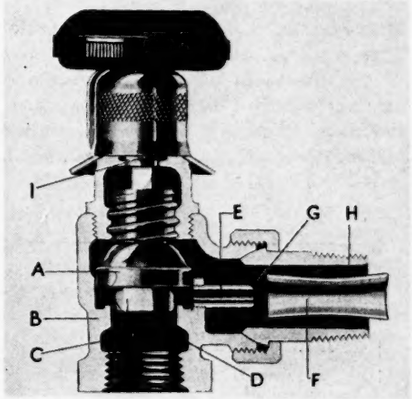
Type SR boilers are made in 24 sizes for each fuel, with capacities in steam radiation ranging from 2310 to 37,600 sq. ft. for anthracite; for the bituminous models, from 2060 to 33,020 sq. ft., and for the oil-burning type from 3300 to 45,650 sq. ft.

Radiator Valve Mixes Steam and Air to Produce Low Temperature Medium

A radiator valve for mixing steam and the air already in the radiator so as to produce a heating medium which has a low enough temperature to have the advantages of water systems, has been placed on the market by the D.G.C. Trap and Valve Co., Inc., 1 East 43rd St., New York. The device is known as the Cryer radiator valve.

In closed position the valve is like any other, a composition disc preventing leakage of steam to the radiator. When the valve is partially open, the slot D is gradually exposed, allowing a small amount of steam to flow through it. This steam passes into the nozzle E and through the Venturi tube F. This flow creates a partial vacuum at G, which circulates the air and steam in the radiator. The Venturi acts in a manner similar to an injector, the velocity of the incoming steam being sufficient, when passed through the small nozzle, to draw in the air and vapor already in the radiator.

When the valve is fully opened the entire seat is exposed, allowing the maximum amount of steam to pass through. The steam enters the radiator through the large port over the nozzle E as well as through the nozzle,



Section of Cryer Radiator Control Valve

and flows through the spud H as well as tube F, so that the radiator will be filled quickly with steam.

Worthington Multi-V-Drive

The Multi-V-Drive method of power transmission has been announced by the Worthington Pump & Machinery Corp., Harrison, N. J. Developed in conjunction with the Goodyear Tire and Rubber Company, this drive consists of a number of endless molded V-belts running in V-grooved sheaves. It combines a long-life type of rubberized cord V-belt, impervious to dust and moisture, with an improved V-grooved sheave.

Emerald Cord belts used in the Multi-V-Drive combine high power capacity, long flexing life, low stretch and accurate cross-section. The load-carrying members are cotton cords arranged in parallel lines and concentrated about the neutral axis.

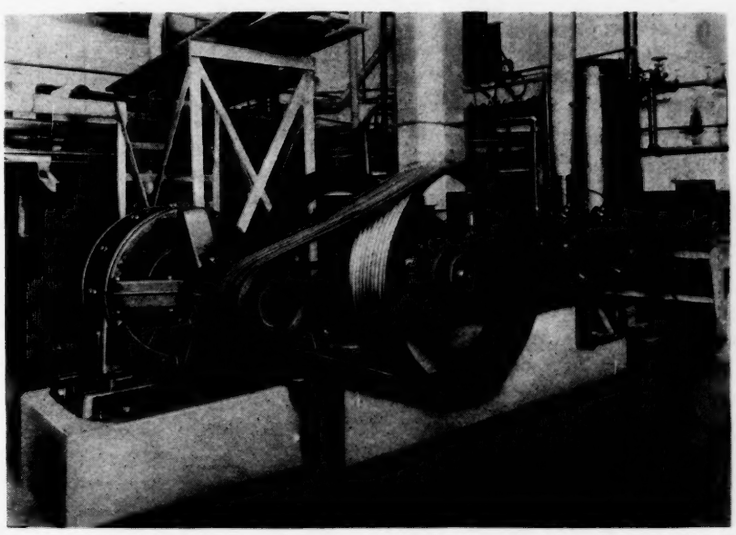
Each sheave is grooved, machined and finished so that the grooves present a smooth surface on which the belts run. The wedging action between the belts and the grooves results in a powerful grip which compensates for initial belt tension in a flat belt drive.

High Speed Fan Announced by Clarage

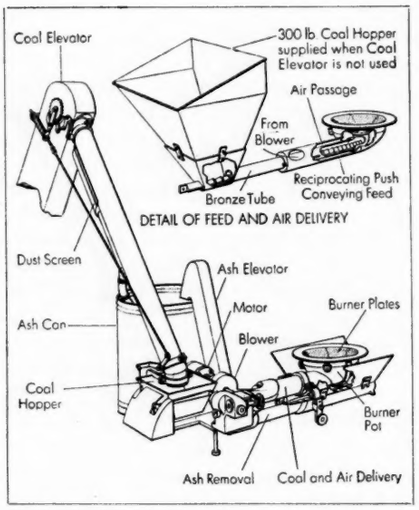
Type HSV fan has been placed on the market by the Clarage Fan Co., Kalamazoo, Mich. This line of fans operates at a speed substantially higher than the ordinary multiblade type of fan, permitting the use of high speed and less expensive motors. It has a full self-limiting horsepower characteristic, which protects the fan against volume overload should the static resistance be less than estimated. The manufacturer claims that in many cases it makes possible the selection of motors one size smaller than customary practice.

The static pressure curve of the HSV fan is relatively steep, assuring only a small change in air volume delivered for variations in the static pressure of a system from estimated static.

HSV fans are made in two designs, No. 1 and No. 2, the first being intended primarily for ventilation and air conditioning, while No. 2 is recommended for forced draft and similar applications.



Worthington Multi-V-Drive



Details of Whitney Coal Burner

Whitney Coal Burner

The invention of George Eli Whitney, a direct descendant of Eli Whitney of cotton gin fame, the Whitney coal burner is being manufactured and sold by the Automatic Heat Corp., 1440 Broadway, New York.

About four years ago Mr. Whitney began work to improve equipment available for house-heating, using coal. While he has introduced no new principle in combustion, he has developed the mechanics of feeding coal into a burner. This is done by using an ingenious plunger feeder conveyor. The plunger feed used in the Whitney burner is a solid cast bronze rod provided with push shoulders, the spacing of which becomes progressively closer in the direction of travel. This feature eliminates the tendency of coal to compact and jam when passing through the coal feed tube; the coal as it travels along the conveyor tends to move faster as it progresses and all tendency toward packing in the tube is eliminated. The result is a saving in power and the ability to use light construction. Equally important with the low power input made possible is the fact that wet coal can be handled, and thus the main objection to small household burners, the matter of dust produced in the basement, is eliminated.

In addition to the features outlined, the burner pot has been sectionalized to reduce the amount of head room required in the heater, and ashes are elevated to allow the use of a full-sized ash can. The whole arrangement is very compact and operation is practically noiseless.

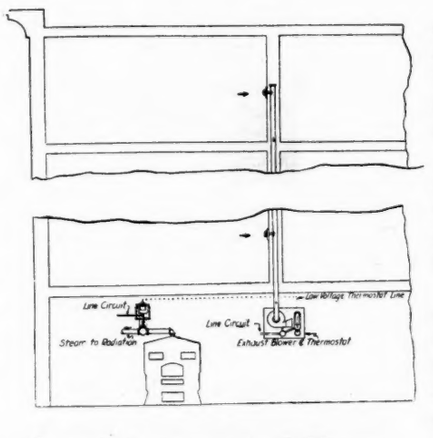
Pacific Red Crest Boilers

Recently announced by the Pacific Steel Boiler Corp., Waukegan, Ill., is the Pacific Red Crest boiler, an all-steel, welded, rock-wool insulated, residence boiler. Welded seams make caulking needless and leakage impossible.

The jacket is of heavy gauge steel finished in smooth baked-on blue enamel with a red top and porcelain enameled doors. Between the boiler and jacket there is a thick blanket of rock-wool insulation, steel wire reinforced.

Suction-Duct System of Thermostatic Control

A system for controlling the temperatures in buildings having many stories has been placed on the market by the Minneapolis-Honeywell Regulator Co., Minneapolis, Minn. A small suction duct is installed leading from each floor to the basement, a uniform sample of air being drawn by a blower through the duct. This air represents a mean temperature of all the floors and is



General Arrangement of Thermostatic Control with Suction Duct System

blown directly on the thermostat which controls the gas or oil burner, coal-boiler dampers, stoker, or steam supply from the district heating company. The inlet to the duct is covered by an adjustable medallion to equalize the resistance in the duct and permit a fair sample to be taken from each room.

In small buildings a single duct is sufficient, while in larger buildings a duct on each of two opposite exposures is recommended. In still larger installations four ducts may be necessary. In new buildings the duct is installed in a partition or wall or, in some cases, in the elevator well. In old buildings the ducts can be brought down through a vertical line of closets.

When used with a clock thermostat or a perpetually-wound electric clock an automatic switch shuts down the exhaust blower motor when the thermostat is set back at night. The system can also be equipped with a special thermostatically controlled inlet valve to close automatically when the room temperature drops, so as to eliminate error in the case of a low temperature unoccupied room.

High-Pressure Boiler and Oil-Burner Unit

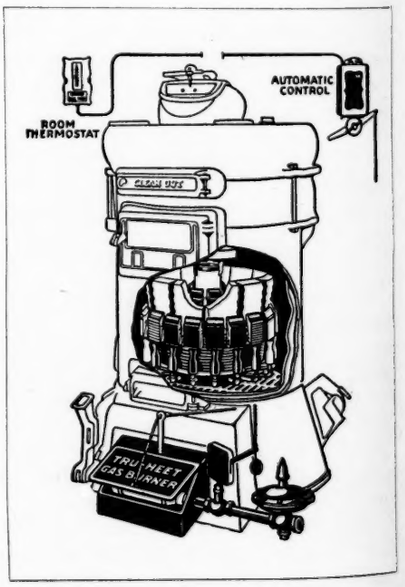
A high-pressure boiler, designed for and equipped with an oil burner, recently was announced by the P. M. Lattner Mfg. Co., Cedar Rapids, Iowa. The boiler is of the all-riveted vertical fire-tube type. A Lattner fuel oil burner is part of the unit, and is of the pressure atomizing type, with electric ignition. The unit is intended for generating process steam, and is made in eight models with capacities ranging from 4 to 40 boiler horsepower.

Tru-Heet Conversion Burner

A gas-fired conversion burner, designed to fit all types of house-heating boilers, has been developed by the Troop Water Heater Co., Pittsburgh, Pa., under the name of the Tru-Heet automatic burner.

It is manufactured in various sizes, and can be adapted with but slight alteration, to boilers originally using coal since the burner is placed on the grate bars.

The unit consists of two batteries of gas burners placed to face the deflectors, each ring being independently controlled. The deflectors serve both as baffles and as a radiant, incandescent surface to distribute the heat. The deflectors are made of specially prepared fire clay.



Tru-Heet Improved Gas Burner

Thermal-Univent System for Schools

A system of heating and ventilating for schoolrooms known as the Thermal-Univent system was recently announced by the Herman Nelson Corp., Moline, Ill. The system consists of a combination of unit ventilators and direct radiation either in panel radiators or in cast-iron radiation, and a thermostat. The system allows for a combination of recirculation and admits of fresh air.

The illustrations show the successive steps in the system from maximum heating to maximum cooling duty.

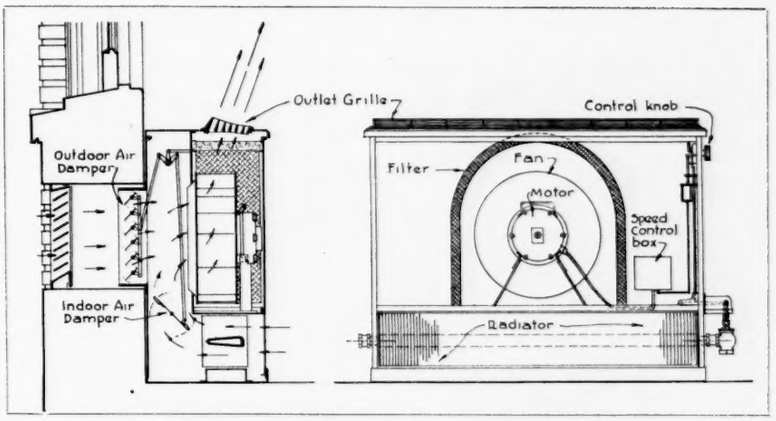
Fig. 1, condition A, shows the system developing its maximum heat capacity for preheating the room in the morning, prior to occupancy. Both the unit ventilator and the direct radiator are delivering their full heat capacity, no fresh air is being admitted, and the room air is being recirculated.

Fig. 2 shows condition B which illustrates the first step in restricting the heat output—that of cutting off the direct radiator, ordinarily shortly after the room has been occupied. The Univent is still delivering heat to the recirculated air but the direct radiator is shut off.

Fig. 3 shows condition C, the steam supply being cut off from both the direct radiator and the unit ventilator. This occurs when there is a condition of thermal balance in the room. It usually occurs when the out-of-doors temperature is between 30° and 35°. In this stage, there is no heat supplied and no out-of-door air admitted for cooling but the system is recirculated. The change from condition B to condition C is a graduated one during which the steam supply to the heating element in the unit ventilator is regulated according to requirements.

Fig. 4 shows condition D which is the first step in cooling. The unit ventilator and direct radiator are still shut off and the recirculating damper is gradually closed and the fresh air damper gradually opened. The illustration shows the dampers in an intermediate position. In the average case the machine will remain in this condition during the afternoon session and the system will deliver more and more out-of-door air for removing excess body heat.

Fig. 5 shows condition E which is the maximum cooling condition of the system in which the recirculated damper is entirely closed and nothing but outside air is delivered by the equipment. In this condition the system will serve to maintain the temperature in the average classroom within 10° to 15° of that of out-of-doors in addition to activating the air.



Side and Front Elevations of Herman Nelson Ventilator

Cycle of Operation of Thermal-Univent System

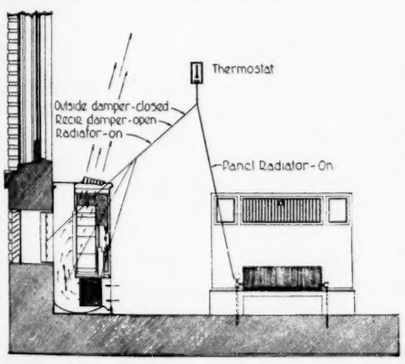


Fig. 1. Univent Adjusted for Full Heat Delivery, Recirculating Room Air

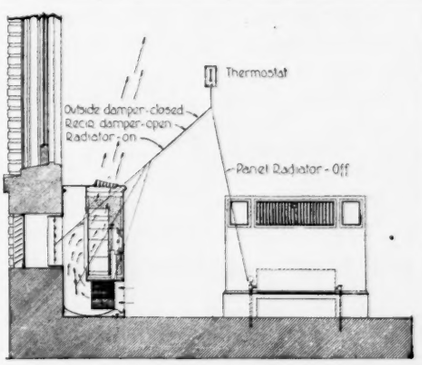


Fig. 2. Panel Radiator Shut Off, Recirculating Damper Open

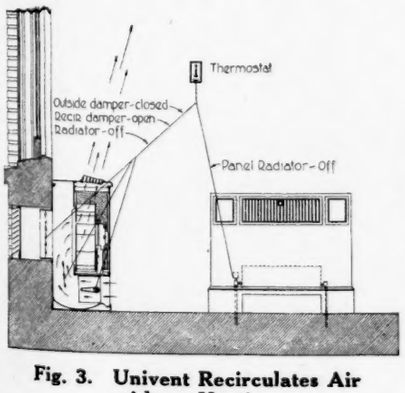


Fig. 3. Univent Recirculates Air without Heating

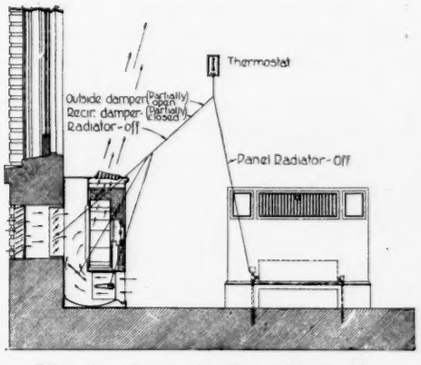


Fig. 4. Some Outdoor Air Is Now Being Supplied

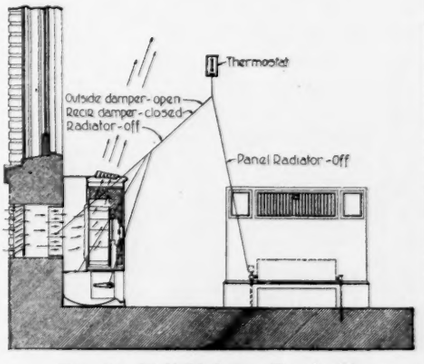
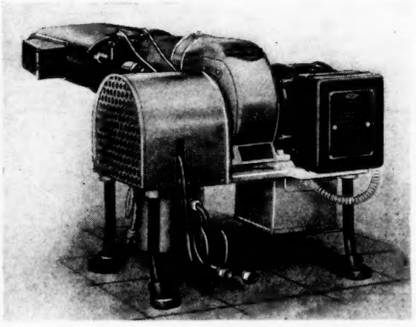


Fig. 5. Full Volume Fresh Air Is Supplied



Wayne J-2 Junior Domestic Oil Burner

Wayne Type J-2 Oil Burner

Similar to the Model D, the Wayne Model J-2 oil burner has been announced by the Wayne Home Equipment Co., Fort Wayne, Ind. The essential features of the new burner are those of the Model D, but the new line has slightly lower capacities.

The J-2 is fully automatic, with four controls as standard equipment, and is approved by the Underwriters' Laboratories. Features include the Wayne double-tube firing head, self-priming pump, and one moving shaft on which the motor, fan and pump are mounted.

The burner is equipped exclusively with electric ignition, and no parts of the burner are in or under the firebox. It is designed primarily for installation in warm-air furnaces, but also can be applied to steam, vapor, or hot water jobs.

Capacities are for installations up to 700 sq. ft. of steam radiation or the equivalent, with a maximum fuel consumption of 2 gals. per hr.

Model S-1 Lewis Air Conditioner

Designed for operation with steam heating systems, the S-1 air conditioner has been announced by the Lewis Corp., Minneapolis, Minn. Based on one air change per hour, this device will provide and maintain any desired relative humidity up to 60% in spaces not exceeding 15,000 cu. ft. The unit is silent in operation.

No motor is required with the machine, which has a humidifying chamber with correctly spaced copper radiator fins on the unit heater, permitting the use of a stack draft gravity principle with a constant flow of air. No tempering is required for the water sprayed on the unit heater as city water at ordinary temperature is used.

Five gallons of water per hour pass through the spray head while the unit is in operation. Of this volume, approximately 10 lbs. are evaporated each hour. This is recommended as the maximum advisable quantity to be provided by gravity from a single unit.

The patented spray head provides uniform distribution of water over the unit heater, the water being in free particles but not atomized. A 100 mesh heavy bronze filter eliminates the probability of spray head cloggage, and an accessible plunger rod permits an immediate and complete flushing of the entire spray head.

Connections include those to the steam heating system, a ¼-in. city water supply line and a ½-in. drain, together with a connection to the Humitrol and wiring to a solenoid valve. Units are assembled at the factory with all piping connections to the floor.

Oil Used as Medium in Electric Storage System

A variation in the system of storing electric energy in water tanks to heat buildings during the peak load hours is reported by Messrs. Browns Dryers, Ltd., 17 Victoria Buildings, Deansgate, Manchester, England.

The main difference between the British system and those used in this country is that oil is the medium rather than water. The oil is contained in a specially lagged tank and is heated by elements wound on porcelain supports, immersed directly in the oil, to a temperature of about 550° F. A further point of interest is that the pressure inside the tank does not exceed that of the atmosphere. As such systems are generally arranged for supply by off-peak current, a time switch or relay is provided to open and close the circuit at the appropriate times.

When the equipment is used as part of a central heating system, the hot oil is withdrawn from the top of a tank to a calorifier, through which it is circulated back to the bottom of the tank. In the calorifier, water is heated for supply to the heating system in the ordinary way. The flow of oil is controlled by valves, the operation of which depends on thermostats placed in the hot water systems, and it can be accelerated by a pump, which is controlled in the same way.

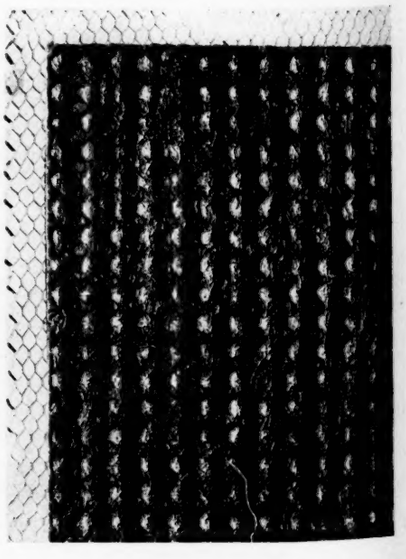
During the night, when the heat required is less than in the daytime, the necessary adjustment may be made by a circulation controller of the double-flow type. One side of this device contains an electrically operated valve, which may be remote controlled, either manually or by a time clock, while the other contains a second valve, which is set by hand to regulate the amount of water that may flow during the night. Both valves are fully open during the daytime.

The system has received a wide application in the impregnating plants, which are employed for withdrawing the air from the coils that form an important part of much electrical equipment and then flooding them with compound or varnish, so as to increase and maintain their insulating properties. In this case the oil is used directly for heating the vacuum tank, a humidity gauge being provided to show when all the moisture has been extracted, so that the compound or varnish can be admitted under pressure.

It is claimed for the system that it can deal at atmospheric pressure with five to ten times as much usable heat as when water is employed. This is due to the fact that the range of usable heat of water is only 20° F. between 180° and 200°, after which it begins to "steam off." The oil used, however, has a range of 400° F., from 180° to 580°, so that though its specific heat is only a little more than half that of water, it has a useful margin ten times as great. In addition, as a smaller weight of oil is required and its specific heat is lower, less time is necessary to heat it to the same temperature.

Bi-Flax Insulating Lath

A metal insulating lath, Bi-Flax, has been announced by Flax-li-num Insulating Co., St. Paul, Minn. Bi-Flax consists of a layer of Flax-li-num insulation permanently attached to diamond mesh metal lath. Insulation and plaster base are separated by a layer of building paper, which prevents the plaster from coming in direct contact with the insulating material. It is furnished in sheets 24 in. x 48 in.

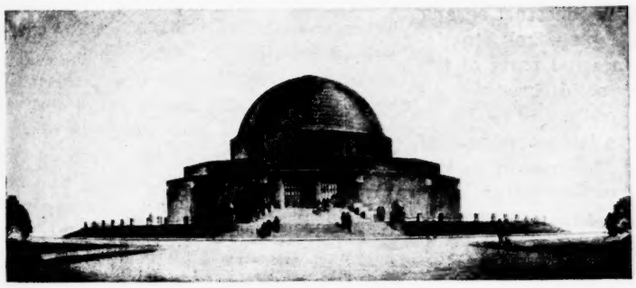


Bi-Flax Insulation

ERNEST A. GRUNSFELD, JR.
Architect

MARTIN C. SCHWAB
Engineer

The Astronomical Museum *and the* Planetarium of Chicago



Chicago's planetarium, the first of its kind in America, is a gift from Mr. Max Adler, former vice president of Sears, Roebuck & Co.

The complex instrument, surrounded by spectators in the large photograph, is the planetarium. It reproduces on an elaborate scale the motions of the 5,400 stars visible to man, and the planets of the solar system.

Here is another prominent building on Chicago's lake front equipped with the Powers System of Automatic Temperature Control.

Wherever the BEST mechanical equipment obtainable is used in a building, you will invariably find Powers Control. Its first cost is often higher, but its greater dependability and long life make it cost much less in the end.

THE POWERS REGULATOR CO.
CHICAGO: 2718 Greenview Avenue
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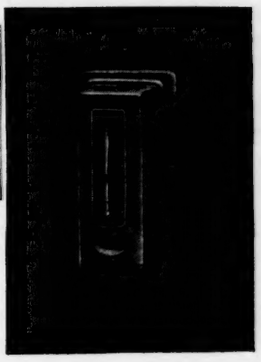
POWERS



THERMOSTATS *are Better Because* they often give 15 to 20 years of Accurate Control without repairs of any kind.

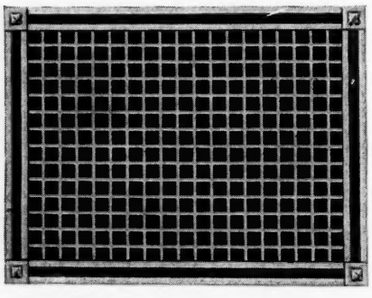
Moisture Meter for Wood

The U. S. Forest Products Laboratory, Madison, Wis., has completed the design and construction of an electrical moisture content meter for wood that is practically instantaneous in its operation, according to an announcement by Carlile P. Winslow, director. The device is moderate in cost and will facilitate the production, distribution, and installation of lumber at the most desirable moisture condition for various uses.

The new instrument is designated the "blinker" machine to distinguish it from others. The indicator consists of a pair of neon bulbs, one of which flashes at a standard rate while the other flashes at a rate determined by the moisture content of the wood being tested. The rate of the flash will be faster than the standard flash if the wood is wetter than the moisture content for which the instrument is set, and slower if the wood is drier. Contact with the wood is made by means of needle points built into a driving hammer. When desired, head phones giving a gentle click may be substituted for either or both neon tubes. The machine can be used conveniently to sort lumber above or below a selected moisture content, or it can be used to measure the exact moisture content by dialing the test flash into approximate time with the standard flash. The compactness and portability of the "blinker" instrument are among its chief merits. Its range is about 8 to 24% moisture content, and it is accurate to about 1% moisture content.

Grilframe

A method of grille construction by means of which the contractor can cut and assemble grilles to any size from stock sheets and frame parts, is announced by the Harrington and King Perforating Co., Chicago, Ill.



(Top) Assembled Grilframe (Left) Parts Ready for Assembly (Right) Grille Secured to Frame by Lug

Frame pieces and grilles can be supplied in various colors and designs which the contractor can carry in stock. Regardless of the size of grille, the contractor need not order special sizes from the manufacturer, but merely cut the frame pieces to the right length, the grilles being sheared from stock sheets to the proper size and the parts assembled on the job. The grille is fastened by machine screws which, when the grille is to be installed, can be taken out and wood screws substituted.

When grilles of metal lace are used, the grille edge is flanged, reinforced with a U-shaped piece of steel, and fastened in place by means of a special stretching lug and screw. This lug fits into a groove in the frame provided for that purpose, and by tightening the screw the grille surface is stretched taut and free from sag.

Kieley Duplex Water Feeder

A Duplex water feeder has been announced by Kieley & Mueller, Inc., 34 West 13th St., New York. The feeder, which weighs 70 lbs., is confined to a rectangular space 18 in. x 18 in. and does not include in its construction any moving parts which are likely to develop trouble. All internal parts of the mechanism are of solid bronze and monel metal.

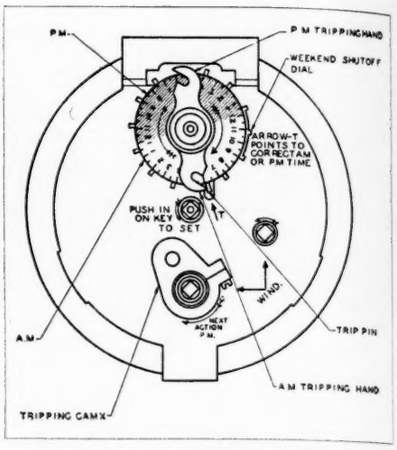
The complete valve is cast as part of the bottom plate of the feeder, and is so arranged as to allow for feeding direct to the boiler. This arrangement retains an effective pressure of the water supply up to the point where it enters the boiler.

Cold water enters below the valve seat, while the discharge side of the valve is sealed with hot water so that steam never comes in contact with the valve. A strainer, self-contained and removable, surrounds the valve orifice and prevents grit from injuring the seat. The valve point and seat are constructed of monel metal.

Opening and closing of the feeder valve is controlled by a seamless copper float which transmits enough power to close the port against an incoming water pressure of 125 lbs. per sq. in.

The valve seat and disc can be removed by unscrewing a plug in the bottom of the valve body and removing the strainer. After the seat is unscrewed the valve stem falls through the seat. Feed connections to the valve are 1 in. for inlet and outlet. The steam equalizer and water equalizer are ¾ in.

Capacities range from 210 gals. of water per hr., under an effective pressure of 15 lbs., to 492 gals. of water with an effective pressure of 100 lbs.



Exact Position of 24-Hr. Dial, Shut-Off Dial and Tripping Cam at 6 A.M. Saturday after Indicator Has Advanced to Day Temperature Setting

Minneapolis-Honeywell Week-End Shut-Off Thermostat

A thermostat which will automatically raise or lower its temperature setting at predetermined hours both night and morning, and so constructed that the clock operation of raising the temperature setting in the morning may be omitted on any day or days by means of a week-end shut-off dial, has been announced by the Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.

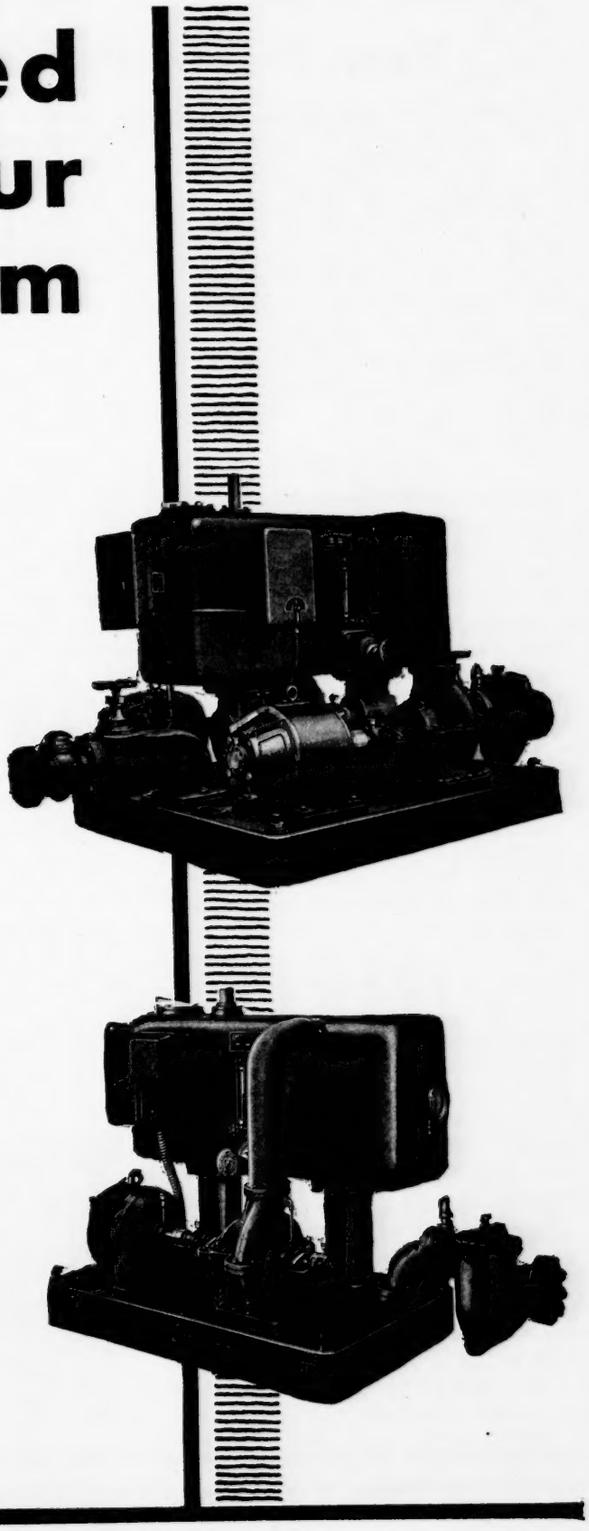
For example, the clock will raise the setting to the day temperature desired Monday morning and lower it to the night temperature at the close of the working day Monday evening, and repeat these operations till Saturday evening. On Sunday, however, the clock will not operate and the setting will remain at the night temperature till Monday morning.

The week-end dial, which accomplishes the shut-down over the week-end or holiday period, is friction driven by the 24-hr. dial unless the trip pin is set to hold it in the desired position. The device is designed for installations in industrial plants which close down over the week-end and holidays.

Stat-Amatic Zone Temperature Control

In the description of the Stat-Amatic zone temperature control on page 124 of HEATING AND VENTILATING for July, it was stated that the change from day to night is made automatically by the clock movement of the thermostat. The article failed to mention that the clock movement of the control unit is motor wound, the thermostat being mounted in the usual position while the clock and motor are located in the basement.

Uninterrupted Service in Your Heating System



The Ames Vacuum Heating Pump will handle the fine core sand, grit, etc., of the heating system that passes through the suction strainer basket—thus insuring uninterrupted service and minimum maintenance costs.

AMES PUMP COMPANY, Inc.
30 CHURCH STREET NEW YORK CITY
Affiliated with
AMERICAN LOCOMOTIVE COMPANY

New Trade Publications

Traps

Data Sheets for Thermoflex Heating Specialties. Grinnell Co., Providence, R. I. This booklet has been issued as a supplement to the announcement of the company's Thermoflex radiator traps, and contains detailed design and specifications relating to these devices. Data sheets outline the uses of the various products and give complete dimensions, capacities, etc. Size 8½ in. x 11 in.

Wright-Austin Steam Traps. Wright-Austin Co., Detroit, Mich. Bulletin No. 211 describes the company's line of "Airxpel" bucket type steam traps, and contains information on their operation, construction and installation, and presents a table of discharge capacities and diameters of valve orifices. Size 6 in. x 9 in. Pp. 12.

Pumps

Motor Driven Automatic Pumps and Receivers. American Steam Pump Co., Battle Creek, Mich. Bulletin No. 24, Edition No. 8, describes the American-Marsh line of motor-driven condensation pumps and receivers. Complete tables of capacities are included for each type manufactured. Size 8½ in. x 11. Pp. 11.

Pump Guide. Chicago Pump Co., 2336 Wolfram St., Chicago, Ill. Booklet No. 12 contains useful information on pumps and their applications, and presents miscellaneous tables, charts and diagrams which will prove of great assistance to engineers. Size 5½ in. x 8¼ in. Pp. 48.

Condensation Return Units. Decatur Pump Co., Decatur, Ill. Bulletin No. 91 describes Series 4700 and 41100 condensation return units and includes a general description of the Burks superturbine pump. Full size reproductions of the working parts of the pump are presented, together with layout diagrams of the systems and a table of theoretical suction lift for water at various temperatures. Size 8½ in. x 11 in. Pp. 14.

Unit Heaters

Universal Unit Heaters. John J. Nesbitt, Inc., Holmesburg Junction, Philadelphia, Pa. Bulletin No. 209 describes the Universal unit heater for banking rooms, showrooms, salesrooms, offices, assemblies, churches and the like. Photographs of such typical installations are included together with capacity charts and specifications. Size 8¾ in. x 11¼ in. Pp. 16.

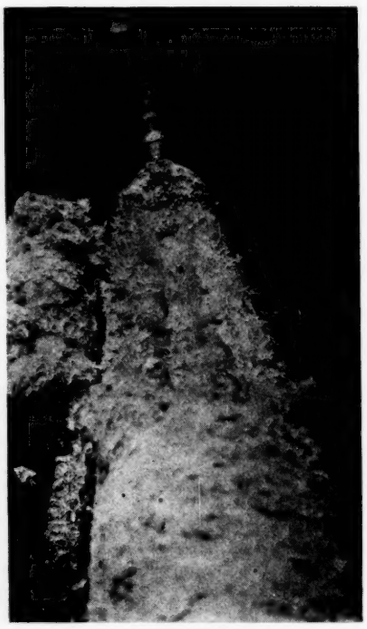
Gas Heating

Sell Health and Comfort in the Home. Roberts-Gordon Appliance Corp., Curtiss Bldg., Buffalo, N. Y. This booklet is addressed to sales executives in the gas industry, and contains two merchandising plans for the sale of this company's conversion burners and duplex systems. Advertising layouts are included, together with sample folders for mailing purposes. Size 9 in. x 12 in. Pp. 20.

Reznor Gas Heaters. Reznor Mfg. Co., Mercer, Pa. The 1930 catalog of this company describes the Reznor Orthoray heater, the Reznor Special, gas radiant, circulating heater, asbestos back heaters, luminous flame heaters, Reznor fireplace, wall insert heater, wall hang heater, Reznor portable garage heater, and warm-air gas-fired heaters. A table of gas capacities of the heaters is included, together with the price list for 1930. Size 4¾ in. x 9½ in.

Insulation

Test on Dry-paC Insulation for Underground Refrigeration Lines. The Ric-wiL Co., Union Trust Bldg., Cleveland, O. A report on a test of 10-in. type F conduit complete with base drain and Dry-paC filler for two 2-in. brine lines. The test showed that the heat loss per minute from the uninsulated line was 171.5 as compared with 10.7 from the insulated pipe, an efficiency of 94%. Actual conditions might improve the efficiency of the insulated line due to the heat resistance of the ground above the line. The earth would also seal the conduit from air infiltration. The base drain would remove any accumulation of water in the ground. Size 8½ in. x 11 in. Pp. 5.



Condition of Dry-paC after 10-Day Test

Oil Burning

The Terrible Tempered Mr. Bang Throws Away his Coal Shovel. Electrol, Inc., 227 East 45th St., New York. The first part of this bulletin is a humorous story by Fontaine Fox concerning one of his characters who had recently installed an Electrol oil burner. The second part is devoted to the subject of automatic oil heat, and is written for the consumer. Size 7½ in. x 10 in. Pp. 23.

Stokers

Whiting Corp., Harvey, Ill., is publishing a series of six booklets on the efficient firing of small boilers, written by Joseph Harrington, who has been for many years a prominent figure in the field of combustion engineering.

"Continuous and Automatic Ash Discharge," the first article in the series, tells of the importance of progressive combustion and efficient ash removal. The second article, "An Even Fuel Bed and What It Means to You," is concerned with the importance of an even fuel bed in efficient firing. Copies of the series will be mailed upon request to the Whiting Corporation.

Air Conditioning

Massachusetts Air Washing and Air Conditioning Systems. The Bishop & Babcock Sales Co., Massachusetts Blower Division, 4901 Hamilton Ave. N. E., Cleveland, O. Bulletin No. 54 is devoted to engineering data on Massachusetts air washers and air conditioning systems. The information and tables presented will prove useful to architects, consulting and heating and ventilating engineers. Size 8¾ in. x 11½ in. Pp. 31.

Amco Humidifying and Air Conditioning Devices. American Moistening Co., Providence, R. I. Catalog No. 1 describes and illustrates the company's line of Sectional, Simplex, and Amtex humidifiers, atomizers, dampeners, electric humidity controls, mechanical psychrometers, electro psychrometers and humidity scales. These devices are manufactured especially for installation in textile mills. Size 8½ in. x 11 in. Pp. 18.

22 TONS *dead weight eliminated in office building heating system*

Cube of church reduced 10,186 FEET

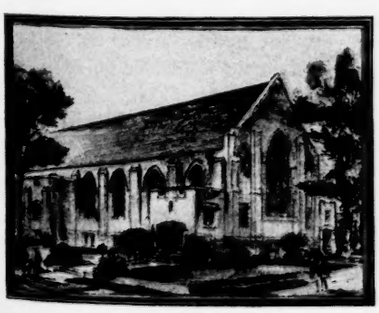
—as modern, low cost Trane Concealed Heaters save money on construction and installation

In a 16-story Southern office building*, if cast iron radiators had been installed, the weight of necessary radiation would have been 56,915 pounds. Trane Concealed Heaters were installed, however. Their total weight was 11,400 pounds, a saving in dead weight of 45,515 pounds—more than the total weight of pipe and fittings.

Referring to a Canadian church, the architect writes:*

"Your suggestion that we use concealed heaters in the nave and transepts enabled us to make a tremendous saving in the cost of construction due to the fact that we were able to reduce the width of the building one foot, eight inches and still retain the original seating capacity. This does not only mean that we made a saving of one foot, eight inches in a building 108 feet long and 57 feet high, but it also, *in this case, means that we were enabled to use lighter beams, floor joists, roof trusses, rafters, etc.*, due to the decrease in span. Our original span was just a little greater than the structural members we are now using would safely carry.

"We have, therefore, due to the use of your system of concealed heating, been able to reduce the cube of the building by 10,186 cubic feet and make a very substantial reduction in the cost of all interior structural members without in any way reducing the capacity of the building or sacrificing its strength and stability."



*Names of buildings, architects and heating contractors on request.

FORGET, for a moment, the low price of Trane Concealed Heat—Forget the durability, the high efficiency of these modern heaters—And you find two additional reasons why Trane Concealed Heaters belong in every building planned and built today: *they save money on construction and installation.*

The two case histories outlined in the next column are typical. For Trane Concealed Heaters consume little space. They are light in weight. They are easy to handle. They are quickly installed by fewer men in shorter time. They save the cost of temporary setting. (Heaters installed in final location provide temporary heat at no extra cost.)

Designed and built to make these savings possible, the Trane Concealed Heater is a masterpiece of compact engineering. Strong, simple, fool-proof and trouble-proof, this heater will last as long as the building it warms.

Simplified design and volume production have brought the price of Trane Concealed Heaters down to the price range of old-fashioned cast iron radiation—for *every* type of building. In the words of Reuben N. Trane, "We know how to make a more expensive concealed heater, but we do not know how to make a *better* one." Write for complete information and architectural details today.

TRANE CONCEALED HEAT

In Walls or In Cabinets

THE TRANE COMPANY, Dept. 8
206 Cameron Ave., La Crosse, Wis.
Send complete information and architectural details on Trane Concealed Heat.

Name.....

Company.....

Street and No......

City.....*State*.....

In Canada address Trane Co. of Canada, Ltd., Toronto, 2, Canada

Trade and Miscellaneous Notes

Coming Events

October 13-17, 1930. Twelfth annual convention and exhibition of the American Gas Association at Atlantic City, N. J. Headquarters at the Atlantic City Auditorium.

October 27-30, 1930. Fifty-ninth annual meeting of the American Public Health Association at Fort Worth, Tex. Headquarters at the Texas Hotel.

February 10-14, 1931. Fifth Midwestern Engineering and Power Exposition at Chicago, Ill. Headquarters at the Coliseum.

Business Paper Editor Nominated for President of A. S. M. E.

Roy V. Wright, who has given 32 years of progressive service to the railway-mechanical industry, as railway mechanical engineer and editor for the Simmons-Boardman Publishing Company, was nominated for president of the American Society of Mechanical Engineers for 1931. Mr. Wright is well known to engineers as having been managing editor of Railway Age, in addition to associate editor and later editor of the American Engineer and Railroad Journal, which is now Railway Mechanical Engineer.

This combined publication will celebrate its 100th anniversary in January, 1932, and is one of the oldest technical papers in existence.

Mr. Wright has made many contributions to technical journalism and also was one of the honorary editors of the Professional Divisions' reports on technical developments since 1880 as published in the Fiftieth Anniversary Issue of Mechanical Engineering.

Williams Oil-O-Matic Convention to Feature Warm-Air Heating

Williams Oil-O-Matic Heating Corp., Bloomington, Ill., announces its sixth international convention which will be held in Bloomington, Ill., August 18-19. It is expected that this year's attendance will exceed last year's total of 3600.

This year the entire warm-air heating industry is being invited to attend. Dealers, salesmen, furnace manufacturers, register and fittings makers are being urged to attend.

George Harms, secretary of the Meyer Furnace Company, and one of the original committee who framed the Standard Code, will be present at the convention. M. E. Ticen, manager of the stove department of the Williams corporation, is in charge of the warm-air division of the convention and will be glad to receive any suggestions of mutual advantage.

Tenth Anniversary Celebrated by Kleen-Heet

Winslow Boiler & Engineering Co., Chicago, Ill., celebrated its tenth anniversary, June 20, when a testimonial dinner was given to its president, William H. Rehm. Mr. Rehm was presented with an engraved silver tray which was unique in that it had individual signatures engraved upon it. This tray was filled with orders which came in from 14 states as an anniversary gift to Mr. Rehm. Dealers from 14 states attended the dinner.

Merc-He-Stat Corporation Formed

The Merc-He-Stat Corporation, a new company to manufacture mercury switches and mercury valves for oil burners and refrigerators, has been formed at Elkhart, Ind. The officers are: President, Carl J. Warnke; vice-president, Lester L. Barker; secretary, Louis E. Buckner; treasurer, George E. Harter; chairman of the board, Charles C. Colbert. Mr. Warnke, Mr. Barker and Mr. Buckner were formerly with the Time-O-Stat Controls Company; Mr. Harter is associated with the Harter Engineering Company, and Mr. Colbert is president of the American Coating Mills.

Miscellaneous Notes

June building operations for the 37 states east of the Rocky Mountains, as reported by the F. W. Dodge Corporation, show a contract total of $600,573,400, the largest construction record since July, 1929. The total for May was $457,416,000 and for June, 1929, the total was $529,891,100. For the first half of 1930 construction contracts aggregated $2,638,013,300. This was a decline of only 12½% from the total of $3,015,546,800 for the corresponding period of 1929. At the end of May contracts for the year to date were 18% behind last year. For the sixth consecutive month public works and utilities were the most important of all classes. This construction amounted to $251,915,800, almost two-fifths of the value of all June awards. The total for residential buildings was $96,815,500; industrial buildings, $93,618,500; commercial buildings, $59,080,000; educational buildings, $48,918,800; hospitals and institutions, $19,675,300; religious and memorial buildings, $11,808,500; social and recreational buildings, $10,187,000 and public buildings, $8,554,000.

In the New England states contracts amounted to $38,089,400 as compared with $36,513,900 for May and $35,472,000 in June, 1929. In Metropolitan New York and Northern New Jersey contracts amounted to $80,324,900 as compared with $96,208,600 for May and $84,810,000 for June, 1929.

Contracts awarded in Upstate New York amounted to $21,456,900 compared with $24,478,300 for May of this year and $22,947,700 for June of last year. Figures in the Middle Atlantic States reached a total of $83,202,200 compared with $37,393,500 for May of this year and $63,794,900 for June of last year.

In the Pittsburgh territory contracts amounted to $62,032,400 compared with $57,009,100 for May and $58,145,100 for June, 1929. Contract figures in Southern Michigan amounted to $19,479,500 compared with $22,170,800 for May and $29,102,100 for June of last year.

The Chicago territory had a contract total amounting to $83,759,600 as compared with $59,468,200 for May and $105,312,000 in June, 1929. The contract total in the Central Northwest amounted to $15,557,400 against $11,015,000 in May and $9,486,000 in June, 1929. The St. Louis territory contracts amounted to $63,483,300 against $21,882,800 in May and $21,058,300 in June of last year.

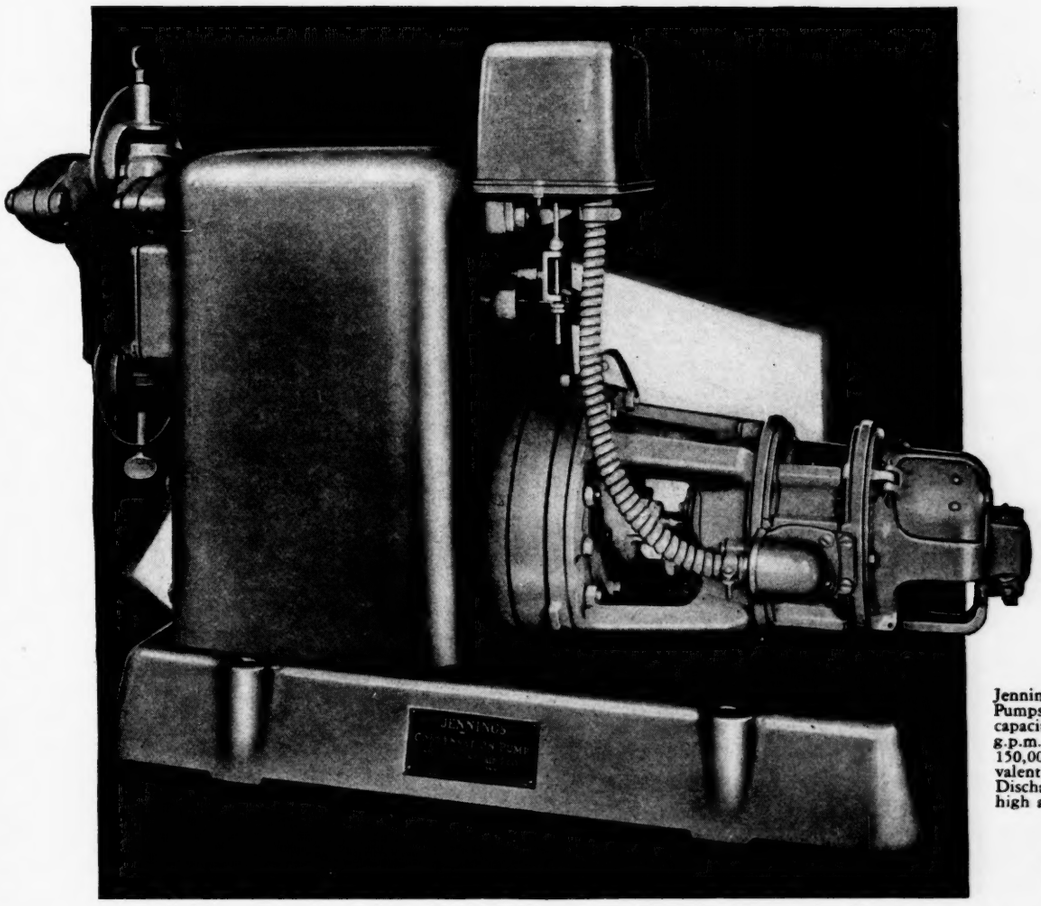
In the Kansas City territory contract totals amounted to $65,233,500 compared with $18,898,700 in May and $22,710,400 in June, 1929. Texas reports contracts amounting to $28,692,200 compared with $14,368,300 for May and $13,822,000 for June of last year.

Figures for the New Orleans territory amounted to $9,195,600 against $14,299,500 in May and $37,930,500 in June, 1929. For the Southeastern territory contract figures amounted to $30,066,500 against $43,709,300 in May and $25,300,100 in June, 1929.

Manufacturers' Notes

Cleveland Gas Burner and Appliance Co., Cleveland, O., announces a change in its company name to the Barber Gas Burner Company.

For efficient operation of basement radiators WITHOUT PLACING BOILER IN PIT



Jennings Condensation Pumps are furnished in capacities of 4 to 200 g.p.m. for serving up to 150,000 sq. ft. of equivalent direct radiation. Discharge pressures as high as 60 lbs.

WHEN installing a steam heating system in a building where basement radiators are too low to provide for the return of condensation to the boiler by gravity, there are two alternatives. The boiler can be placed in a pit... a costly job at best. Or a condensation pump can be installed.

Especially designed for this service, the Jennings Condensation Pump is a compact, economical unit. This pump receives the condensation and delivers it to the boiler. Automatically controlled, it keeps the system free from water and assures a full flow of steam.

The Jennings Condensation Pump will give years of trouble-free service. The centrifugal impeller and its casing are mounted on one end of the receiving tank. A rigid bracket supports the motor, and insures alignment of shaft and working parts independent of the base. No detail has been overlooked which makes for long life and economical operation. Occasional lubrication and infrequent repacking are the only attention required. *Write for Bulletin 99.*

NASH ENGINEERING COMPANY
81 Wilson Road So. Norwalk, Conn.

Jennings Pumps

Reliance Electric & Engineering Co., Cleveland, O., has advanced J. L. Van Nort to the position of sales engineer of the Boston office.

Chicago Pump Co., Chicago, Ill., announces that R. J. Welsh, 503 Healy St., Atlanta, Ga., has been added to its list of representatives.

Whitehead Metal Products Co., of New York, Inc., 304 Hudson Street, New York, announces that Franklin E. Devlin has become associated with the company.

S. T. Johnson Co., Oakland, Cal., has appointed Hunter A. Hammill as sales engineer of the Philadelphia factory branch. The following representatives have been appointed: A. O. Wigglesworth, Madison, Wis.; C. S. W. Oil Burner & Electric Co., Princeton, N. J.; O. C. Williams, Cloverdale, Cal.; Rogers Heating Co., Champaign, Ill.; Freeport Battery Service Co., Freeport, Ill.; C. J. Evelien, Elgin, Ill.; H. C. McGlauflin, Petaluma, Cal.; Phillip Eagar, Inc., Long Branch, N. J.; O'Hara Equipment Co., New London, Conn.; Charles E. Walsh, Jr., Co., New York; Waters Co., Monterey, Cal.; Hall Sheet Metal Works, Chico, Cal.; I. N. Scammell, Montague, Cal.; Harry N. Binns, Bakersfield, Cal.; Edward Holtz, Santa Rosa, Cal.; Watchung Appliance Co., Plainfield, N. J.; Johnson-Worcester Oil Burner Co., Worcester, Mass.; Central Supply Co., Springfield, Ill.; H. B. Delong Co., Spokane, Wash.

American District Steam Co., North Tonawanda, N. Y., has appointed the Laney Company, 935 Kennedy Building, Tulsa, Okla., as its sales representative for the state of Oklahoma.

Garden City Fan Co., Chicago, Ill., reports that at its annual meeting of stockholders the following officers were elected: President, H. C. Richards; vice-president and general manager, W. Gardner, Jr.; secretary and treasurer, T. J. Flanagan. Mr. Richards, with headquarters at Niles, Mich., has been vice-president of the company for 13 years and in charge of the manufacturing end of the business for over 20 years. Both Mr. Gardner and Mr. Flanagan have been associated with the company for over 20 years and will conduct its affairs from headquarters located in the McCormick Bldg. at Chicago. These changes were due to the death of E. D. Green, former president and treasurer.

Coatesville Boiler Works, Coatesville, Pa., announces the recent acquisition of the Middletown, Pa., plant of the Standard Steel Car Company (Pullman Corporation). The addition of this new property to the present shops of the company makes its capacity the largest in America devoted exclusively to steel plate fabrication. Approximately one half million square feet of floor space comprise this property. It is expected that the new plant will be in partial operation in about six weeks and in full operation within the next three months. The boiler works will continue to operate its foundry, pattern and machine shops in East Coatesville.

Combustioneer, Inc., Goshen, Ind., manufacturers of automatic coal burners, announces the appointment of Lorin W. Smith, Jr., as sales promotion manager. Mr. Smith, who formerly was sales promotion manager of the Jewell Division of the Minneapolis-Honeywell Regulator Company, has been active in organizing, and is a member of the Committee of Ten of the Coal and Heating Industries.

New York Blower Co., Chicago, Ill., announces that William I. Lawson is now associated with the company as sales manager, and will be located at the general offices at 32nd St. and Shields Ave., Chicago. Mr. Lawson has been engaged in heating and ventilating work for many years.

Cutler-Hammer, Inc., Milwaukee, Wis., has acquired all common stock of Schweitzer & Conrad, Inc. of Chicago. This latter company will continue to operate as an independent manufacturing and selling unit and no changes in organization or personnel will be made except that Beverly L. Worden, president of Cutler-Hammer has been elected president of Schweitzer & Conrad and will serve both companies. Messrs. Conrad and Schweitzer have been retained as consulting engineers and will continue their interest in the management as members of the board of directors.

The Louis Allis Co., Milwaukee, Wis., has opened three new sales offices with the following men in charge: C. O. Sargent, 1715 Union Bank Bldg., Pittsburgh, Pa.; W. Woobank, 215 B East Archer St., Tulsa, Okla.; A. R. Thomas, 4441 Santa Fe Ave., Los Angeles Cal.

Modern Coal Burner Co., 3733 Lincoln Ave., Chicago, Ill., has appointed C. G. Wooley as district manager on the north side of Chicago. Ray Glaspell, formerly with the Fire King Mfg. Company also has been appointed district manager on the south side of Chicago. J. M. Staub has been made district manager on the north side of Chicago.

The Prest-O-Lite Co., Inc., 30 East 42nd St., New York has placed in operation a new plant for the manufacture and distribution of dissolved acetylene at Casper, Wyo., located at 648 Bryan Stock Trail.

Pittsburgh Equitable Meter Co., Pittsburgh, Pa., held a salesmen's meeting in conjunction with the annual convention of the American Water Works Association, June 2-6 at St. Louis. W. F. Rockwell, president of the company, expressed satisfaction as to the sales for the first part of 1930, and stated that they were ahead of last year. M. J. Harper, who has handled the export sales of the company for many years, as well as taking care of many important accounts in the New York territory, has been appointed manager of the company's New York City office to succeed Victor E. Arnold.

Monash-Younker Co., Chicago, Ill. manufacturers of steam specialties, announces that its New York office, which for 20 years has been located at 121 West 42nd Street, has been moved to 67 West 44th Street.

Jenkins Bros., 80 White St., New York, announces that the board of directors has elected James R. White a vice-president of the corporation and director of sales.

F. H. Peavey & Co., one of the largest grain marketing organizations in the United States, has acquired a controlling interest in the Flax-li-num Insulating Co., St. Paul, Minn. H. B. Harden, for many years associated with Johns-Manville Corporation has been appointed general manager and sales director. J. B. Gilfillan, president of Van Dusen-Harrington Co., one of the Peavey controlled corporations, has been made president. Frank Evans is secretary-treasurer.

American Radiator Co., New York, has appointed H. G. Kreissl manager of the Vento and Arcoblast Division of the company. Mr. Krissl has been associated with the American Radiator Company since 1905, the end of the present year marking a period of service of 25 years with the sales division of the company. Three of these years were spent abroad selling for the German branch.

Hoffman Specialty Co., Waterbury, Conn., has appointed Ralph Emerson as manager of the Detroit office.

Winslow Boiler & Engineering Co., Chicago, Ill., reports that Byron K. Eaton has resigned his position as district manager of the Kleen-Heet Division.

Johnson Service Co., Milwaukee, Wis., announces that J. A. Cutler, who has been with this company since 1912, and manager of the Chicago offices for the past seven years, has been elected vice-president and also a director of the company.

Doherty-Brehm Co., Minneapolis, Minn., has appointed John Owen, formerly with the Landon Radiator Co., Inc., as a member of its staff.

Change of Address

W. D. Cashin Co., Boston, Mass., has moved to its new office and factory building at 69A St., South Boston.

THE SPEED HEATER HAD TO BE SEVERAL JUMPS AHEAD!

WHAT chance would just "another unit heater" have had?

When introduced . . . Speed Heaters *had* to be several jumps ahead in design and construction . . . in order to even survive!

But Speed Heaters have more than survived. Thousands already have been installed! Architects, engineers, contractors and users . . . all have endorsed them.

High Pressure Aerofin in *all* units . . . for all pressures up to 350 lbs. Specially designed fans . . . 2 speed motors. Strap Hangers . . . furnished. Vertical Louvres . . . an exclusive Sturtevant feature . . . use optional. And exceptionally low prices . . . because of quantity production!

These are merely a few highlights to give you some idea of Speed Heater design . . . construction . . . value.

Why not have *all* the Speed Heater data on tap? The coupon is handy. Mail it . . . now!

SHIPMENT FROM STOCK

Speed Heaters for all standard voltages, A. C. and D. C., are carried in stock at conveniently located storage points throughout the country. On-the-dot shipment is assured!

B. F. STURTEVANT CO.

Main Offices: HYDE PARK, BOSTON, MASS.—CHICAGO, ILL., 410 No. Michigan Ave.— SAN FRANCISCO, CAL., 681 Market St. *Branch Offices in Principal Cities.* Canadian Offices at: Toronto, Montreal and Galt. Canadian Representatives: Kidd Kelly, Ltd., Winnipeg. Agents in Principal Foreign Countries.

Sturtevant
(REG. U. S. PAT. OFF.)
SPEED HEATERS

COUPON

B. F. STURTEVANT CO., Hyde Park, Boston, Mass.

Kindly send me a copy of the Speed Heater Data Book.

☐ Check here . . . . . and one of our men will gladly call.

Company _____

Street _____

City _____

H. V. 8-30

Classified Advertising

Advertisements under this heading, $2 per inch, payable in advance. A 1-in. advertisement contains about 35 words in this size type. Larger type and spacing at $2.00 per inch. To secure insertion copy must be received not later than the 20th of the month preceding date of issue.
HEATING AND VENTILATING — 521 Fifth Ave., New York, N. Y.

PRECISION

is a synonym for our service when we are mentioned by the Heating and Ventilating industry. The exactness of our operating methods in research has been given the stamp of national recognition by those whom we have served in the past.
All branches of Heating, Ventilating, Air Conditioning, District Heating and allied problems find ready reference in our completely equipped Laboratories. Correspondence from manufacturers, architects and engineers is cordially invited, and assurance is given of our fullest co-operation.

FROST
RESEARCH LABORATORY
INCORPORATED
1326 Markley Street NORRISTOWN, PA.

The New York Blower Company requires successful and experienced fan and unit heater salesmen. For further information address The Sales Manager, 3155 Shields Avenue, Chicago, Ill.

SALES REPRESENTATIVE WANTED—An excellent opportunity with unlimited financial possibilities, either as direct salesmen or as sales representatives, is offered, covering a complete line of vacuum, vapor and steam heating specialties, a complete system of temperature regulation, fans, air washers, and unit heaters. Only those with technical education and thoroughly experienced in one or more of the lines will be considered. Give complete history of selling experience with reference to territory covered, name of company now associated with, etc. Applications confidential.

THE BISHOP & BABCOCK SALES CO.
Cleveland, Ohio

Increased Activity in rapidly expanding markets has made it necessary to increase the number of our representatives. Sales engineers experienced in these or similar lines are invited to write. If your territory is open, this may mean a valuable connection.

JAS. P. MARSH & CO.
Division of Commercial Instrument Corp.
2073 Southport Avenue, Chicago, Ill.

—WANTED—

Manufacturer's Representatives

We have several openings for high class representatives to contact distributors and dealers, having exclusive selling franchises on the Wayne Oil Burner and Wayne Electric Refrigerators. Applicant must have successful record in sales together with sound engineering education. An unusual opportunity for men handling not in excess of two or three non-competitive lines. State full details of experience, territory desired and companies represented at the present time.

WAYNE
HOME EQUIPMENT CO.
FORT WAYNE, IND.

An Opportunity to Dispense With Your Sales Force

Manufacturer's representative engaged in promotional work to architects and dealers, and selling jobbing trade, is inaugurating an expansion program. Would consider exclusive representation for full line of steam specialties and kindred lines. Equipped with office and engineering sales force. Territory, Indiana, Illinois, Wisconsin and Eastern Iowa with headquarters at Chicago. Address Box 122, care of Heating and Ventilating.

Steel Heating Boiler Company with very complete lines has some territory open for sales organization or representative having had experience calling on engineers, architects and heating trade. Address Box 123, Heating and Ventilating.

Position Wanted: Designing engineer thoroughly experienced in heating, ventilating, piping and dust collecting, desires position preferably in middle west. Address Box 120, Heating and Ventilating.

BIG BUSINESS SAYS!

"Prepare NOW to reap YOUR share in the coming years of great business Prosperity."
HARKEN to this Command, O Ye Shop Owners, Salesmen, Mechanics, and others. Fortunes will be made in these next few years by those who KNOW. Devote this Summer to personal preparation in a technical way for going after the bigger paying jobs—the ones with the larger yearly incomes. Build big with big prosperity; our Engineering Service is at your command. Check the subject you prefer, and mail today—full information is free.

- ☐ Heating and Ventilating Engineering.
- ☐ Special Steam and Water Heating.
- ☐ Scientific Warm Air Heating.
- ☐ Plumbing and Sanitary Engineering.
- ☐ Contracting and Estimating.
- ☐ Mechanical Drafting.

Saint Louis Technical Institute
Est. 1910.
The most thorough institution for Technical Home Study to-day.
4543 Clayton Avenue St. Louis, Mo.

WANTED: Young man with engineering and operating experience in the Heating and Ventilating Industry, to become Sales Engineer for long established manufacturer of recording instruments for pressure, temperature, electricity and motion; and automatic controllers for temperature, pressure and humidity (both air and electrically operated types). Candidates preferred who have had both industrial experience and scientific education, and who are free to travel through the great industrial districts. Highest character references required. Write, stating experience, age and salary desired. Address Box 121, care of Heating and Ventilating.

—WANTED—

Boiler Sales Representatives

We have a complete line of steel Heating Boilers and require experienced Sales Representatives to handle our account in territories at present uncovered. In reply give full information with details of experience and companies you are now representing.

THE WICKES BOILER CO.
SAGINAW, MICHIGAN

Have You Bought Your 1930 A. S. H. and V. E. Guide?

THIS year's edition was much larger than any previous one but the material in it has had such an unusual appeal that the supply is almost exhausted. *The Guide* is indispensable to those who want to keep posted on the latest developments in the field. It has over 1000 pages, 6 x 9 inches in size and is well illustrated. A glance at the chapters listed below will give some idea of its scope.

CONTENTS BY CHAPTERS:

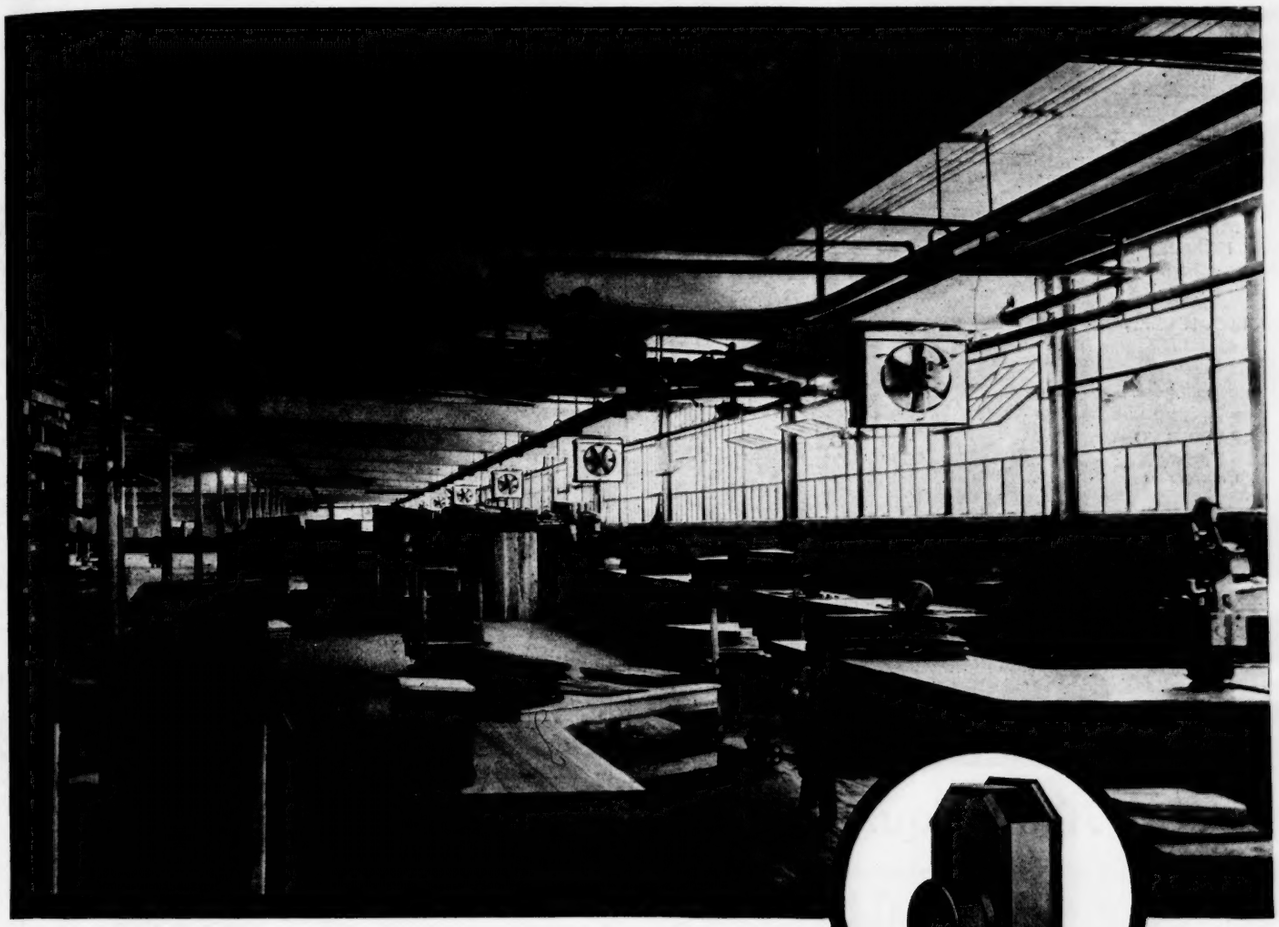
1. Codes and Standards; 2. Heat Losses from Buildings; 3. Standards of Ventilation; 4. Ventilating Systems; 5. Heating with Warm-Air Furnaces by Gravity; 6. Heating with Warm-Air Furnaces by Fan Pressure; 7. Air Conditioning and Cooling; 8. Air Cleaners; 9. Unit Heaters and Air Conditioners; 10. Heating by Coal; 11. Heating by Gas; 12. Heating by Oil; 13. Heating by Electricity; 14. Chimneys; 15. Boilers; 16. Conductors and Convectors for Steam and Hot Water Heating; 17. Automatic Heat Control; 18. Pipe and Fittings; 19. Pumps and Traps; 20. Piping for Steam Heating Systems; 21. Piping for Hot Water Heating Systems; 22. Piping and Equipment for Laundries, Kitchen and Hospital Service; 23. Water Supply Piping for Buildings; 24. Heat Insulation for Pipes and Surfaces; 25. District Heating; 26. Selection of Fans and Motive Power; 27. Air Ducts; 28. Pneumatic Exhaust Systems; 29. Drying by Evaporation; 30. Ozone and Ventilation; 31. Notes on Requirements for Special Types of Buildings and Service; 32. Specifications; 33. Physical Properties, Weights, Measures, etc.; 34. Symbols.

Enclosed find $5.00 for one A. S. H. & V. E. Guide

Bound in Flexible Fabrikoid, Only $5.00, Delivered

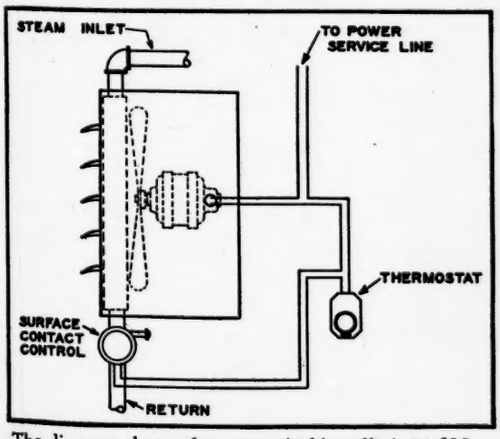
..... **HEATING AND VENTILATING, 521 Fifth Ave., New York**

Factory of the Red Lion Cabinet Co., Red Lion, Pa. *Heating Contractors,* Lindemuth Engineering Co. *Heating Engineers,* Paul E. Sowers Co.



Mercoid Thermostat No. 855

56 MERCOIDS control these UNIT HEATERS



The diagram above shows a typical installation of No. 855 Mercoid Thermostat and Mercoid Surface Contact Control connected to a Unit Heater.

The Contact Control operates by the temperature of the condensation line. The fan cannot start until the pipe is warm. Insures complete venting and prevents cold air coming from heater.

The Red Lion Cabinet Company is one of the largest manufacturers of radio cabinets in the world. In their modern factory at Red Lion, Pa. 56 Sturtevant Unit Heaters are installed—each controlled by Mercoid Thermostats which maintain a constant even temperature. All over the country in buildings large and small Mercoid is controlling unit heaters. But this is only one of the many applications of Mercoids for they have a wide use in heating and general industrial work.

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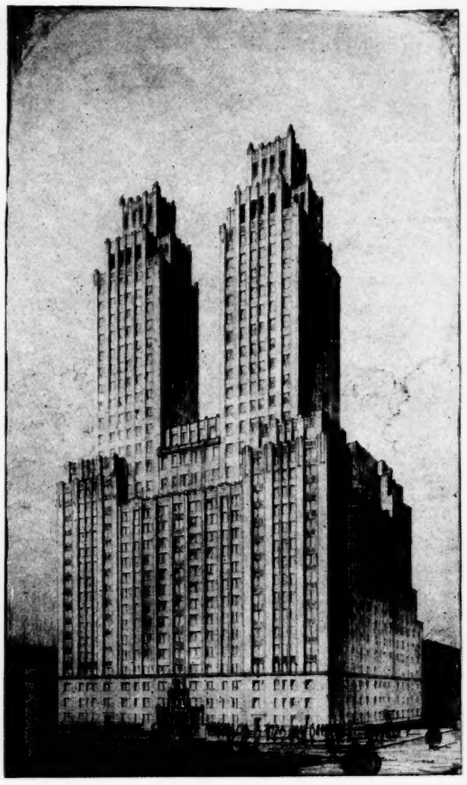

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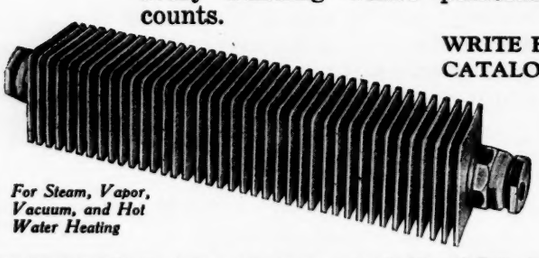

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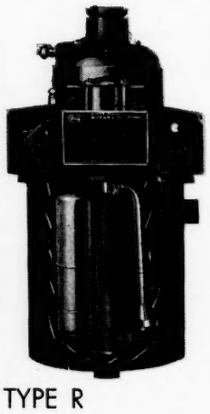

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Four Tons of Dust in Air, New York's Big Problem

Engineers Told by Prof. Free of Ever Present Menace to Health

The solution of the dust problem is the solution of the dust problem in scientific minds, Prof. H. E. Free of New York University declared to-day before the 2,000 delegates at the fifth annual convention of the American Society of Mechanical Engineers at the Engineering Societies' Building, No. 29 West 39th Street. The convention, which opened yesterday, will continue until Friday.

From four to five short tons of dust particles are continually floating through the atmosphere of the city, said Prof. Free, who arrived at this conclusion after a recent survey in which dust and soot particles were counted by a dust counter. This device was slightly modified from the instrument used by Dr. J. S. Owens, of London, in various tests of dust conditions in the British capital, the speaker said.

The majority of Prof. Free's tests, he said, were made from the 17th floor of a building at Fifth Avenue and 32d Street. His investigation developed that soot comprised at least 90 per cent. of the said particles ordinarily encountered in the atmosphere about the city.

Apartments and houses were responsible for the vast amount of soot he said, and not the large power houses and other industrial plants, as is often charged. Other materials observed during the tests were particles of rubber from automobile tires, asphalt, brick and tarb dust, slivers of glass. The glass particles, he said, were presumed to be minute flakes scaled from glazed tile used in building.

"Little practical importance attaches to the calculations of the total amount of suspended soot in the city air," he said. "It may be said, however, that the average over New York City on the basis of my counts appears to be one ounce avoirdupois for each 10,000,000 cubic feet of air. For the air over the entire city the amount is from four to five short tons."

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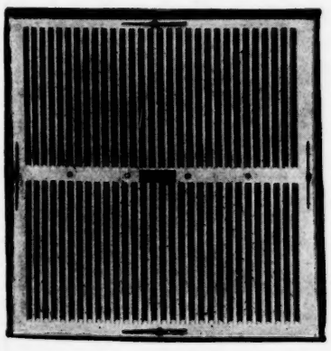

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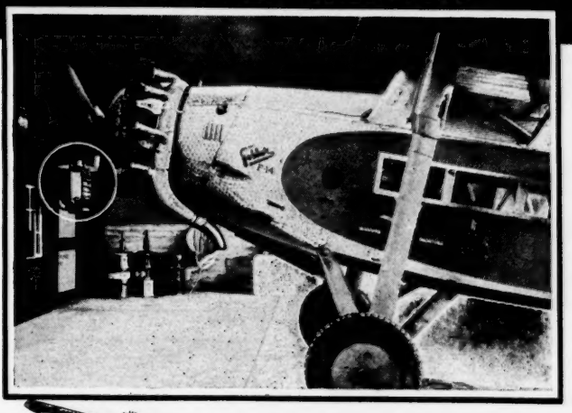

Interior view of airplane hangar at Calgary, Alberta, Canada, which is heated with Humphrey Gas Unit Heaters. Forty degrees below zero is a common temperature during the winter months in Calgary.

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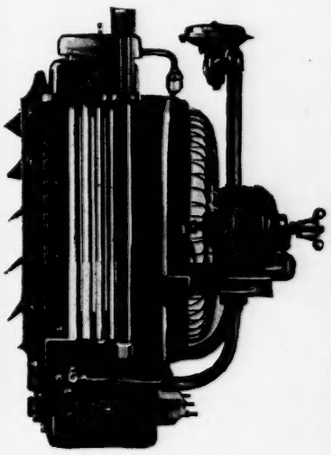

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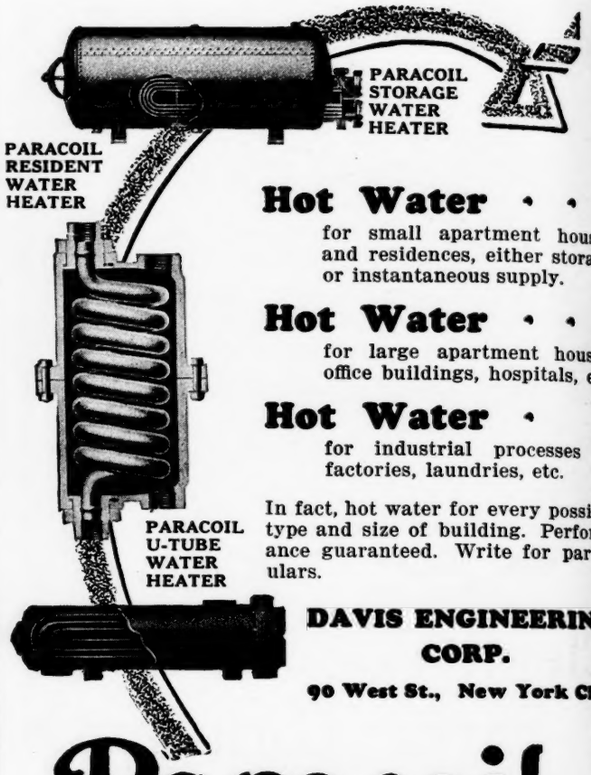

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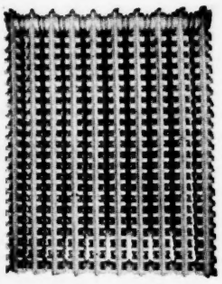

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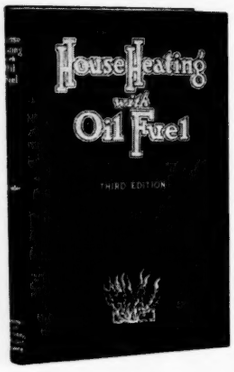

Have You Read This Book?

Every reader of this magazine should be fully posted on the developments in the use of oil fuel in house heating; whether he is selling equipment for it, or meeting it as competition. There is no better source of information than this unbiased treatment of the entire field by P. E. Fansler, E.E. 150 especially prepared photographs, diagrams, and charts are used to illustrate it. A glance at the Table of Contents given below will show how comprehensive and up to the minute it is.

Contents by Chapters

1. The Era of Automatic Control. 2. The Use of Liquid Fuels For House Heating. 3. Oil Fuels —Definitions, Characteristics & Specifications. 4. Oil Fuels— Source, Preparation and Distribution. 5. Combustion—Theory. 6. Combustion — Practical Considerations. 7. Boilers For Use With Oil Burners. 8. Boilers Particularly Adapted to Oil Burning. 9. Warm Air Furnaces For Use With Oil Burners. 10. Oil Burners — Types — Characteristics. 11. Oil Burners — Atmospheric. 12. Oil Burners — Mechanical Draft. 13. Oil Burners—Mechanical Draft (continued). 14. The Control of Oil Burners. 15. Oil Burner Accessories. 16. Tanks & Storage. 17. Efficiencies. 18. The Iso-Degree Day Chart and the Iso-Oil Consumption Chart. 19. The Value of House Insulation. 20. Selling Oil Burners. 21. How Many Gallons of Oil Equal a Ton of Coal. 22. Checking the Radiation. 23. Checking the Heating Plant Installation. 24. Installing the Oil Burner. 25. The Underwriters' Regulations. 26. Heating Service — Servicing Oil Burners. 27. Buying An Oil Burner. 28. What the Underwriters' Listing Means. 29. Domestic Oil Burners Listed By the Underwriters' Laboratories. 30. Oil Burner Ordinances. 31. Oil Burner Fires. 32. Bibliography.

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Contents: I—Physical Units and the Measurement of Heat, II—Water, Steam and Air, III—Fuels and Combustion, IV—Steam Heating Boilers and Hot-Water Heaters, V—Draft and Chimneys for Heating Boilers, VI—Heat Transmission of Buildings and Insulating Materials, VII—Estimating Seasonal Heating Requirements for Various Types of Buildings, VIII—Heat Transmission and Dimensions of Direct Radiators, IX—Direct Steam Heating, X—Exhaust Steam Heating, XI—Direct Hot-Water Heating, XII—Heating Water in Tanks and Pools, XIII—Electrical Heating, XIV—Ventilation, Air Analysis and Ventilation Laws, XV—Gravity —Indirect Heating by Steam and Hot Water, XVI—Warm-Air Furnace Heating, XVII—Hot-Blast Heating, XVIII—Air Conditioning, Air Washing, Humidifying, Cooling and Drying, XIX—Automatic-Temperature and Humidity Control, XX—Central Station or District Heating, XXI—Pipe, Fittings, Valves, and Accessories, XXII—Preparations of Plans, Specifications and Estimates.

Gravity Steam and Water Heating, by Ara Marcus Daniels. This practical series of thirty (30) loose-leaf booklets covers the fundamentals of heating and ventilating, gives technical instructions for the design and layout of all types of steam, water, vapor and vacuum systems, and includes descriptions of conventional pipe connections, fittings and appliances used with such installations. Special chapters are devoted to a discussion of the capacity, dimensions and particular features of various types of radiators. Fundamentals of steam properties, the combustion of coal, and a description of various types of boilers are treated, together with special chapters on chimneys and draft. The author has had many years of experience in the Bureau of Home Economics in the U. S. Department of Agriculture. Published in loose-leaf form in two special canvas ring binders. Price $12.50.

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Heating and Ventilation, by Charles W. Brabbee. This is the first American edition of the famous Heizungs-und Luftungs technik, by Dr. H. Rietschel, and C. W. Brabbee, translated from the seventh German edition, edited and revised to make it adaptable to conditions in the United States. Supplemented by 7 charts covering steam and water heating and ventilation. 332 pages, 6 x 9 Inches. Cloth $4.50.

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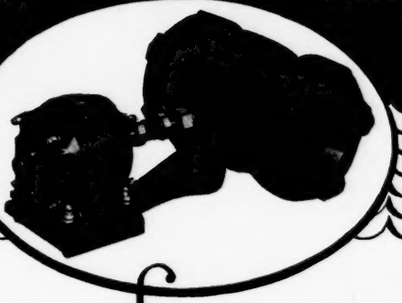

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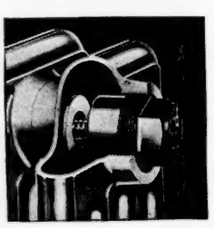

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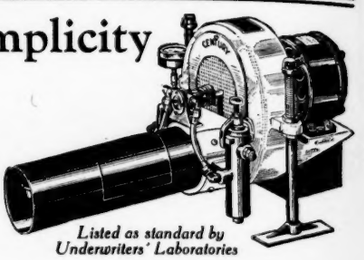

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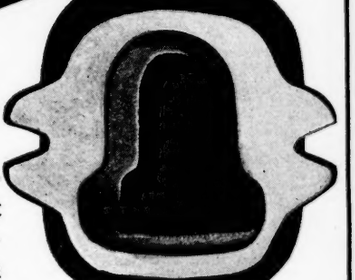

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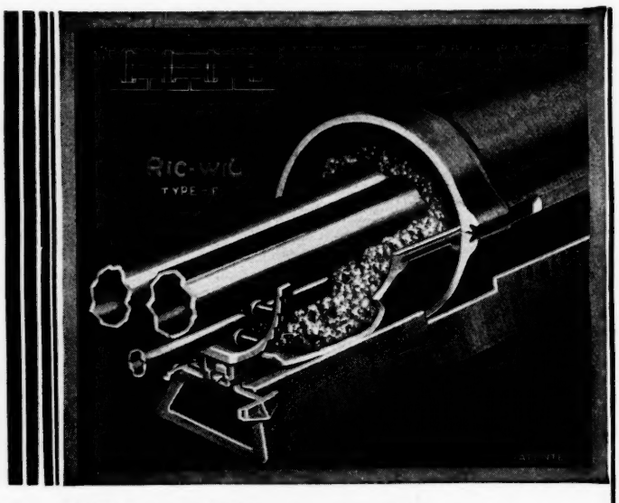

IF YOU WANT A PERMANENT JOB

Cross section of RIC-WIL Type F, Tile or Cast Iron Conduit, showing multiple pipe support.

—if you want to be positive that your underground heating pipes will be permanently protected and efficiently insulated, you will want a RIC-WIL installation. With RIC-WIL on the job you can forget your underground pipes for all time. A leak is the only possible cause for repairs—and RIC-WIL construction makes pipe repairs easier and less expensive than with any other type.

—and RIC-WIL is more than a product

RIC-WIL Engineers have devoted over twenty years to the problem of insulating and protecting underground pipes. No matter what your problem may be, they can recommend an installation that will meet your every requirement. They do all the preliminary engineering work—you will find the actual installation of RIC-WIL is a speedy and simple mechanical job because complete Service Details are furnished with each RIC-WIL order.

RIC-WIL Engineering Service is at your disposal. Write for specifications, A & E Sheets, and Service Details of typical installations.

The Loc-liP Side Joint on RIC-WIL Conduit is so shaped that the cement is locked in place and also locks the two halves firmly together, making a permanently watertight joint. This Loc-liP Joint adds to the strength of the conduit and provides a closed, waterproof housing for the pipes and Dry-paC insulating filler. It is one of the important exclusive features of RIC-WIL construction.

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RIC-WIL
UNDERGROUND CONDUIT

Makes a ton of coal do the work of two —

BROWNELL

IN every phase of stoker performance the Brownell is the undisputed leader.

And there is a type and size to meet every requirement

We have put aside all inclination to discuss technical facts with our readers. We do, however, emphasize the 75 years of boiler room experience behind the Brownell stoker and the unparalleled plant facilities of Brownell shops for its manufacture.

The logical leader in the field and unquestionably superior by every known basis of comparison—all of which is self-evident to heating engineers who stop to investigate. Get Bulletin S-51.

The Brownell Guarantee is backed by the great nation-wide Brownell Organization—in business for over seventy-five years, and the only firm making both Boilers and Stokers.

HEATING BOILERS AND STOKERS

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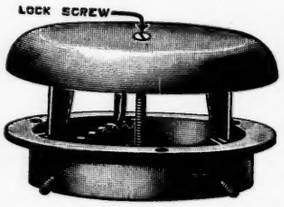
Still the Best!



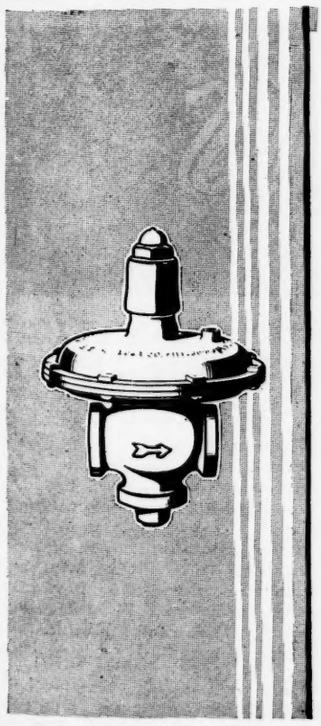
Twenty years ago Knowles was the *only* air diffuser used in auditorium ventilation. It is found that these are still giving satisfactory results, which is without doubt one of the reasons why Knowles improved mushrooms are preferred by Architects and Engineers.

Use NU-NOTCH and avoid trouble and expense. NU-NOTCH is Simple, Rigid, and easily adjusted in recessed notches. For any kind of floor. Also flat tops for low seats.

Write for Detail

Knowles Mushroom Ventilator Co.
41 No. Moore Street, New York City
***Established* 1909**

FOR CONVERSION BURNERS . . . . EMCOS



Heating engineers and contractors, who have had experience with the installation of gas-fired heating equipment, know that pressure regulators help to give high efficiency, economy and make satisfied customers.

Then, why not install EMCO Gas Appliance Regulators. Take advantage of OUR years of engineering experience.

Pittsburgh Equitable Meter Co.

Main Office and Factories—Pittsburgh, Pa.

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• To Pipe Heat Was Too Costly— *Clow Gasteam Radiators* Solved It •

The four isolated Observation Towers, at the four corners of the great stone wall surrounding the Holmesburg Prison, Philadelphia, required heat. To pipe it from a central heating plant would have been prohibitively expensive, and impractical, due to the large heat loss that would have resulted.

This heating problem was solved by placing two 26" Vented Clow Gasteam Radiators in each tower. Comparative cost was low.

Now, day or night—at a moment's notice—real steam heat is available. No costly piping—installation is simple.

But this instance is only one of countless heating problems that have been solved by Clow Gasteam Radiators —from the smallest room to the largest building—from north to south, east to west—dry or humid climates. Write today for further information on this tried and proven heating system.

JAMES B. CLOW & SONS
201-299 N. TALMAN AVE. CHICAGO, ILLINOIS

CLOW GASTEAM

Steam Heat with Gas

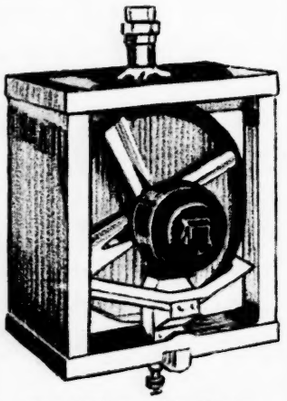
Unit Heater Motor Stopped After 26,353 Hours of Continuous Operation

Broken Belt Ends Remarkable Test
Shaft and Bearings in Fine Condition
No Lubricant Added During Run

As a matter of interest to unit heater manufacturers, The Emerson Electric Mfg. Company gives the following information covering a test which was run on an Emerson motor in an effort to determine certain thrust characteristics when used with a fan for unit heater application. This motor was a 1/20 h.p., 1750 r.p.m., 110 volts, 60 cycles, standard in every way, operating a well-known unit heater.

The motor was operated for the entire period of the run without additional lubricant other than that supplied during the assembly of the motor.

A total operating time of 26,353 hours was obtained, no additional lubricant being supplied. The run failed at the end of this time due to no inherent fault of the motor or bearings, but rather due to the breakage of a belt on an adjacent endurance run, the broken belt lodging in the fan blades, blocking them and causing the motor to burn out.



Type of Motor and Application Used in 26,353 Hour Test

Ample Lubricant Remained

Upon examination of the parts of the motor it was found that while most of the wool packing in the oil reservoir was comparatively well dried out, there was ample lubricant around the bearings; the shaft showing practically no wear other than that anticipated during this period of operation. Wear due to the thrust of the fan was negligible.

In every respect the motor was still in excellent operating condition as far as shaft lubrication and bearings were concerned, and there is every reason to believe that, with an additional supply of oil, barring the unfortunate accident, the motor would have continued to operate many times this long.

The record of 26,353 hours is equivalent to 1,098 days at twenty-four hours' continuous service per day, or 3,294 days at eight hours per day. Assuming the average heating season to be 200 days, and the average period of operation of the unit heater for factory service eight hours per day, the run would represent an equivalent of sixteen years and five months of service. The above assumption is on the basis of automatic temperature control, allowing for partial day-time and extremely intermittent night-time operation.

In addition to the type of motor used in this test, a complete line of Emerson motors in sizes ranging from 1/30 to 1 h.p., inclusive, is available for direct drive, air-moving apparatus. This line includes split phase, D. C., 3-speed capacitor motors, polyphase motors for single or 3-speed operation. Fan duty motors carried in stock can be furnished either with sleeve bearings, wool packed, or with ball bearings. In either case, sufficient lubricant is packed in the motor bearing reservoir to insure at least one year's operation without re-lubrication. All Emerson motors of corresponding speeds and ratings are physically interchangeable. The Emerson Electric Mfg. Co., 2018 Washington Ave., St. Louis; 806 West Washington Blvd., Chicago; 155 Sixth Ave., New York City.

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QUALITY HEATING SYSTEMS

QUALITY, in design, workmanship and materials, insures SATISFACTORY OPERATION.

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128 Brookside Ave. Jamaica Plain, Boston
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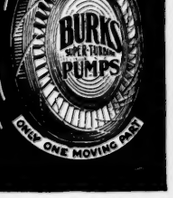
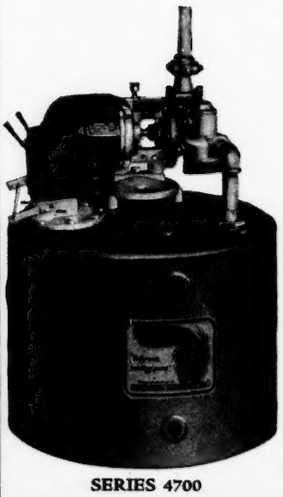
Modulation Vapor and Vacuum Heating Systems of Proven Quality

BURKS SUPER-TURBINE PUMPS





SERIES 4700

CONDENSATION RETURN UNITS

"High and Dry"

No need to subject your Condensation Pump to the dirt, grease, and water usually found in the boiler room sump or pit. Powerful suction, even when handling HOT water, enables the Burks Super-Turbine pump to perform effectively when mounted on TOP of the receiver tank.

Will Not Steam-bind

Only one moving part—the impeller. Pumps air alone to full pressure rating of the pump, hence will not steam-bind. Investigate this outstanding pump.

Send for Bulletin No. 91, which describes this new Condensation Return Unit fully. Write today.

DECATUR PUMP COMPANY DECATUR ILLINOIS

EMERSON FAN DUTY MOTORS

Farrar & Watmough, Architects
Henry Mandel Building Co., Inc., Builders
E. I. Daugherty & Co., Consulting Engineers for Plumbing
J. L. Murphy, Inc., Plumbing Contractors.

Important Apartment Colony Equipped Entirely with

Patterson Hot Water Heaters

The 12 fine buildings in *London Terrace*, ranging from 16 to 19 stories in height and containing 1,000 high-class apartments, cover an entire block in New York City.

And, as usual with such projects, precautions were taken to make no mistakes in selecting equipment, so the occupants of these buildings will be amply supplied with hot water from *10 Patterson Heaters.*

Buyers of Patterson Hot Water Heaters take no chances. For these heaters are guaranteed by a 50-year-old concern to furnish all the hot water required, as hot as required and as quickly as required.

May we send you our catalog?

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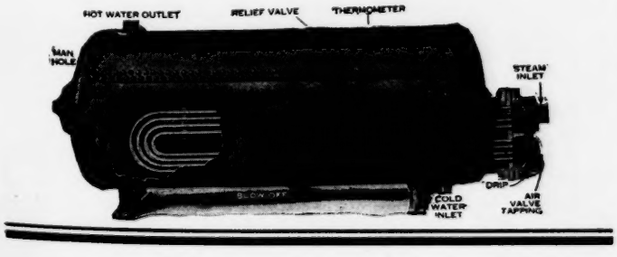

Architect, Donaldson & Mier; Gen. Contractor, Martin Krausmann Co.; Heating Contractor, H. Kelly & Company; Our Representative, H. A. McDonald, 2-237 General Motors Bldg., Detroit.

Another Skyscraper Uses SYLPHON EXPANSION JOINTS

This is the David Stott Building in Detroit. You will find Sylphon Packless Expansion Joints on its steam and return risers. Sylphon Expansion Joints are always steam tight, yet are free to move without jamming. Easily installed, no packing necessary.

The Sylphon Expansion Joint occupies very little more space than an ordinary pipe fitting. Unlike the expansion loop which is assembled on the job by expensive labor, the Sylphon Packless Expansion Joint comes to the job completely assembled and ready to be installed. Thousands in use are giving satisfaction, eliminating repacking cost and worry, and above all, allowing the heating system to operate at its full advantage.

Write for Bulletin PH-300—just off the press. No obligation.

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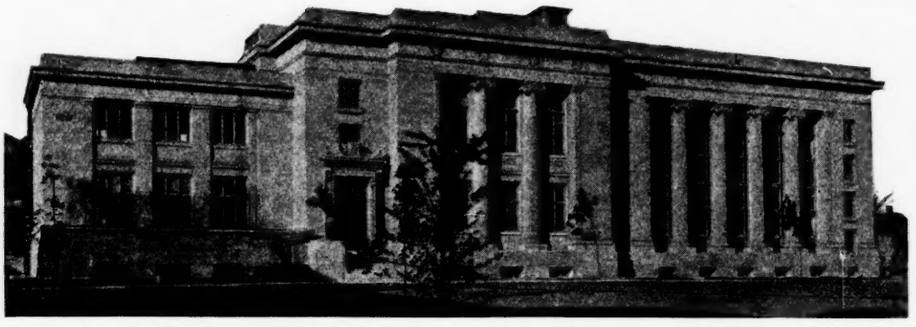

CHOOSES *DUO-STAT* CONTROL FOR THE HEAT IN LANGDELL HALL

The Raymond Duo - Stat controls the supply of steam to the converters in this building to maintain the circulating water at a temperature which is proportional to the outdoor temperature. This control insures a circulating water temperature which is automatically raised or lowered, without any manual attention, according to the following schedule:—

Outdoor Temperature	70	60	50	40	30	20	10	0
Water Temperature	80	95	110	125	140	155	170	185

Other Duo-Stats vary this schedule to suit the requirements of other buildings. The Duo-Stat is also made for steam heating systems

ENGINEERING CATALOGUE FURNISHED ON REQUEST

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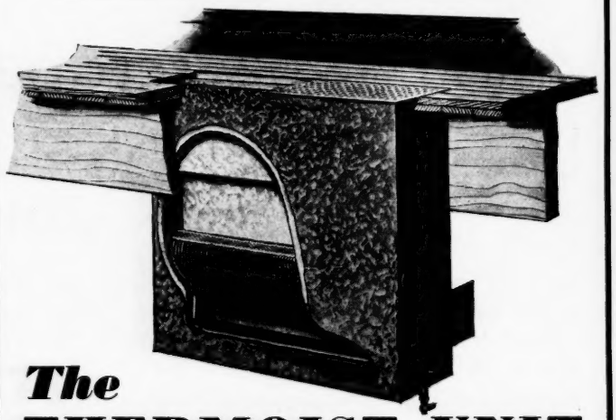
HEAT—HUMIDITY UNDER CONTROL



The THERMOIST UNIT

A combined heater and humidifier. Sturdily constructed. Easily installed in houses both old and new.

These units supply automatically the proper amount of humidity for health and comfort in the home.

PROPER HUMIDITY MEANS COMFORT—HEALTH—ECONOMY

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Yes, we will

On request we will send this Atlas Junior Catalog No. 21 which is devoted entirely to our Regulating Valves and Devices. We have a copy for every reader of Heating and Ventilating. In which of the following are you interested?

- ☐ Reducing Valves
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REGULATING VALVES FOR EVERY SERVICE
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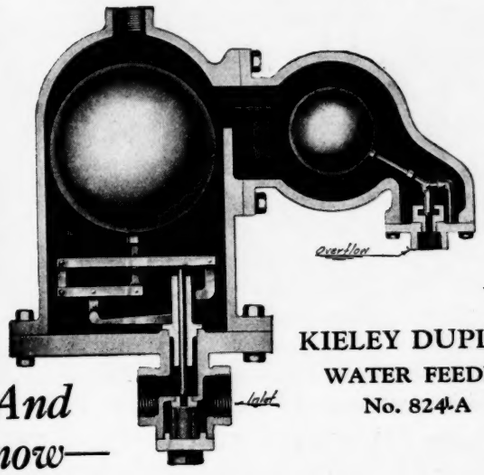

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WATER FEEDER
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And now—

a feeder that offers boiler feed protection. Unsurpassed for design, simplicity, cost and reliability.

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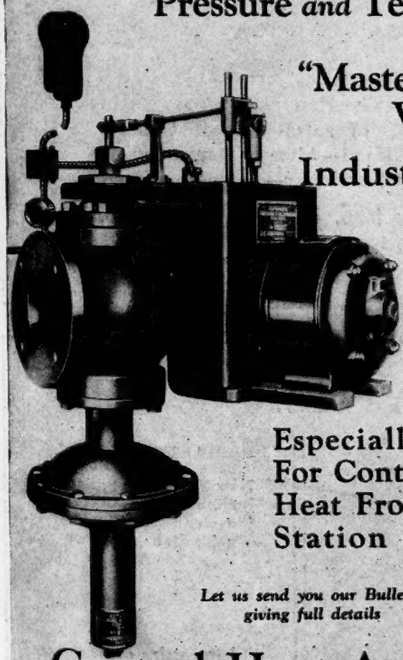
HORNUNG

Pressure *and* Temperature
2 *in* 1
"Master Control" Valve
(PATENTED)
Industrial Type



Motor Operated Directly by Thermostat

All Relays Eliminated ... ...

Especially Designed For Control of Steam Heat From a Central Station

Let us send you our Bulletin giving full details

Central Heat Appliances
J. C. HORNUNG, *Engineer*
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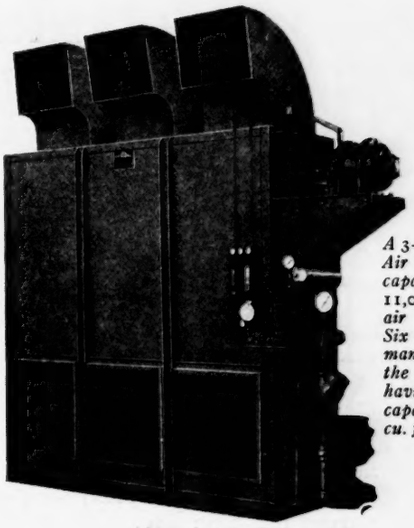

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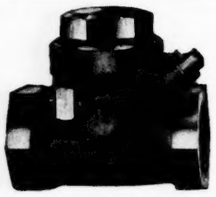

Fig. 0601

FAIRBANKS Swing Check VALVES

STRAIGHTWAY AND ANGLE PATTERN

Fig. 0701

These well-known Horizontal Swing Check Valves with Rotating Disc work freely, never sticking on the seat.

They have full area equal to pipe connections, and straightway passage; are thoroughly tested and reliable. Can be easily reground without disconnecting from the pipe line.

Made in Bronze, Semi-steel with Bronze Mountings or All-Iron construction. For Steam Working Pressures up to 250 pounds or Water Working Pressures up to 350 pounds.

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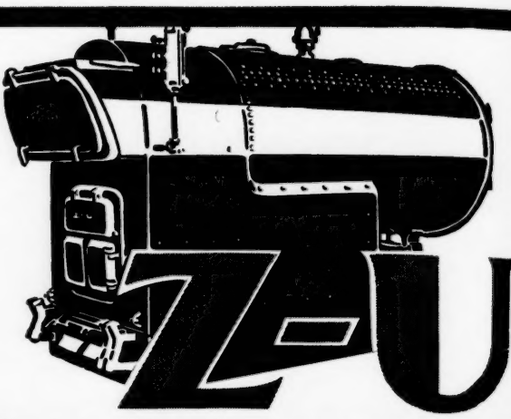
Factory: Binghamton, N. Y.

Distributors Everywhere



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for Steam or Hot Water Heating

Smokeless, Up-Draft, Oil-Gas-Stoker Types 4000 to 34,000 sq. ft. steam radiation. Noted for remarkably QUICK PICK-UP and ECONOMICAL PERFORMANCE.

Catalog gives full details. Write for a copy.

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New STAT-AMATIC CATALOG

Tells how Stat-Amatic is solving unlimited problems of heat control and temperature regulation including its great value in connection with Unit Heaters.

You should have this catalog HV8.

Stat-Amatic Intrument & Appliance Co.

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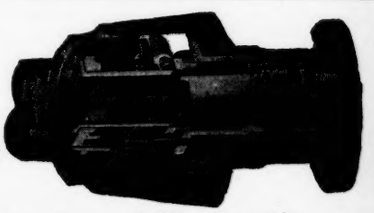
ROSS

Crosshead-GUIDED Expansion Joint Excels in



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"Every day a *good* day"
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Humidification, Dehumidification
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Cooling of Public and Industrial Buildings
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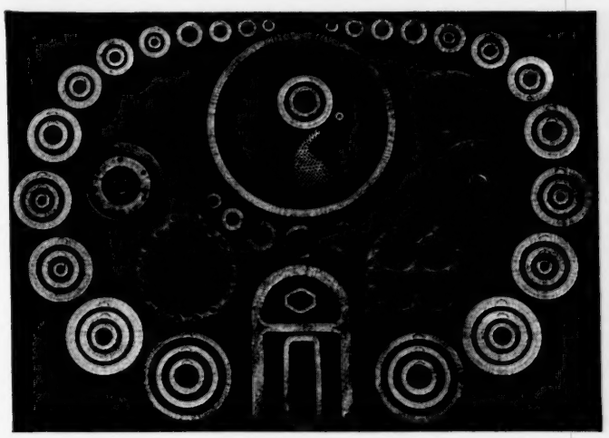
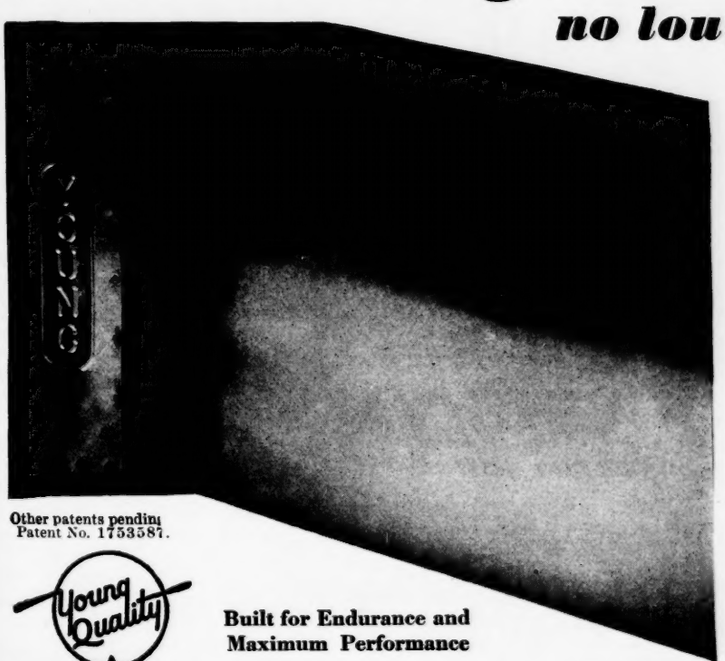


A Few Types of Goetze Gaskets

What Is Wrong With This Picture?

no louvers—of course!



Other patents pending
Patent No. 1753587.

Young Quality

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Built for Endurance and Maximum Performance

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NO louvers, and yet the smoke travels downward at a sharp angle. This test demonstrates conclusively that the slightly slanted flat fin of the Young Unit Heater directs the air downward before it reaches the louvers . . . This eliminates the usual backlash and resistance, permits the louvers to more easily deflect the heated air to the working zone, and provides a more comfortable temperature over a larger area.

This unit heater was installed in this foundry last year, the louvers being removed only for demonstrating the air delivery.

YOUNG RADIATOR COMPANY

Heating Division

RACINE WISCONSIN

Representatives in Principal Cities

Correspondence Invited on Open Territories

Young Unit Heaters

A GOOD BOILER RETURN TRAP will provide the simplest and best means of returning condensation to an ordinary steam heating boiler where equipment has little or no attention.

A cheap trap of ordinary construction will sooner or later fail — a broken boiler—that's all.

The Simplex "Valve in the Head" trap with bronze and nickel steel valves and working parts is a distinctly superior piece of equipment built for lifetime service.

Send us your next order, pay the small difference and let experience be your guide.

SIMPLEX HEATING SPECIALTY CO., Inc.
LYNCHBURG, VIRGINIA

CHACE THERMOSTATIC METAL
"It Bends With the Heat"

An accurate, consistent and durable bi-metal for temperature responsive devices up to 1500° F. Mill sheets or finished form. Consult our Eng. Dept.

Manufactured by
W. M. CHACE VALVE COMPANY
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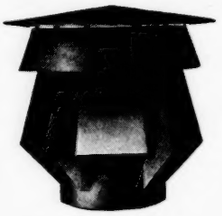
Specify ÆOLUS IMPROVED VENTILATORS



ÆOLUS Improved Double Syphon Ventilators give 10% more power than formerly, according to Armour Institute Tests.

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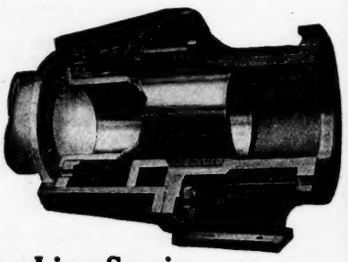
HOWARD Guided Expansion Joint



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Eliminates trouble from Expansion and Contraction, saves space, labor and repair bills; the construction is mechanically correct.

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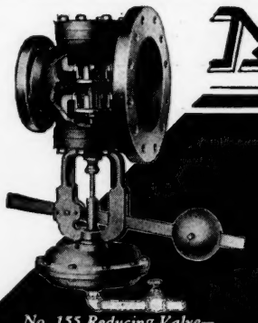

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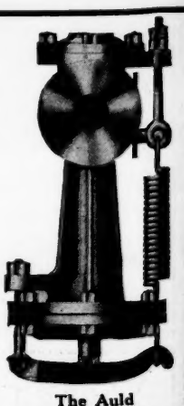

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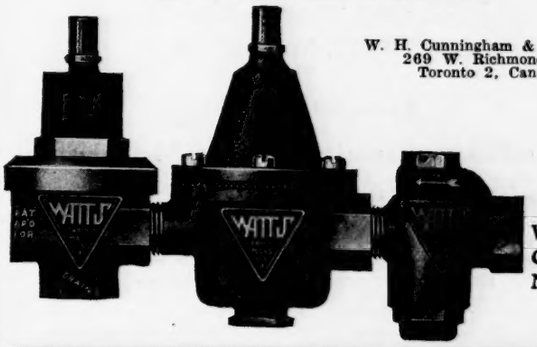

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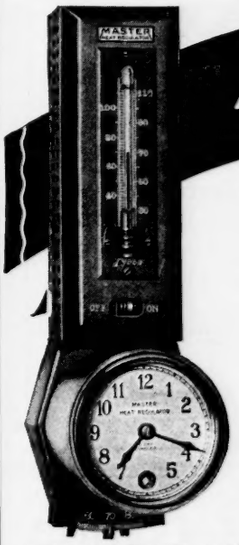

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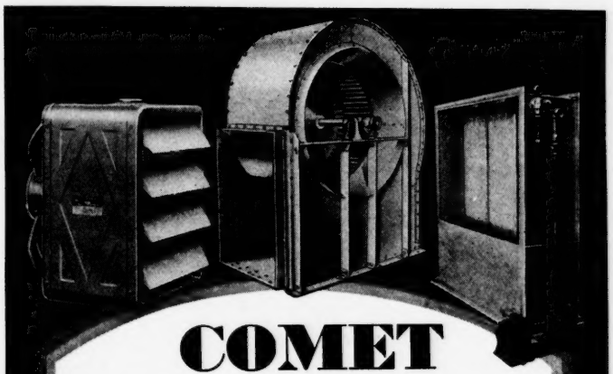

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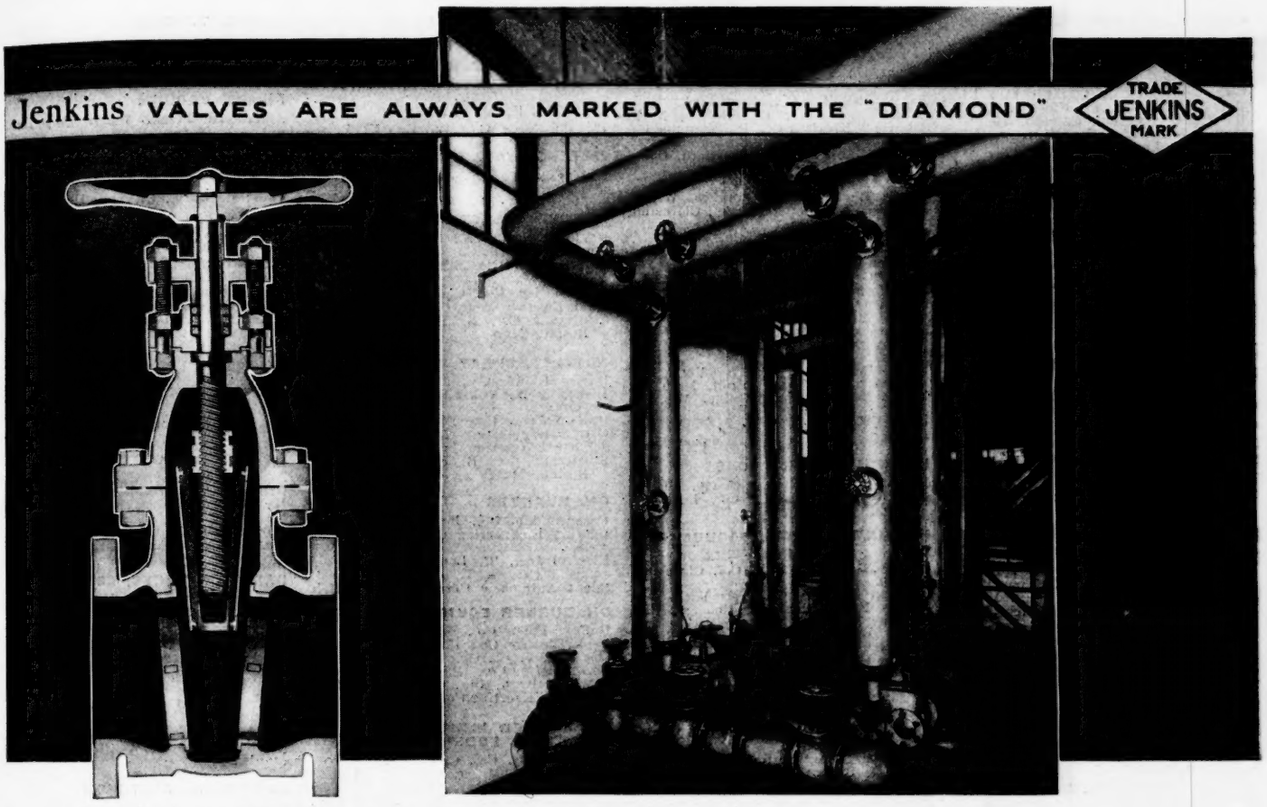

Left: Sectional view, Fig. 326, Jenkins Standard Iron Body Gate Valve, flanged. Above: Fig. 326 valves and Fig. 128, Jenkins Extra Heavy Bronze Globe Valves in intake lines, and Fig. 106, Jenkins Standard Bronze Globe Valves in discharge lines on feed water pumps.

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Pittsburgh Equitable Meter Co., Pittsburgh, Pa.

GAUGES, WATER
Bristol Co., The, Waterbury, Conn.
Crane Co., Chicago, Ill.
Marsh & Co., Jas. P., Chicago, Ill.
Mercoid Corporation, Chicago, Ill.
The Stack Heater Co., Boston, Mass.

GENERATOR COOLING SYSTEMS
American Air Filter Co., Louisville, Ky.
American Blower Co., Detroit, Mich.
Bayley Blower Co., Milwaukee, Wis.
Bishop & Babcock Sales Co., Cleveland, Ohio.
Buffalo Forge Co., Buffalo, N. Y.
Schutte & Koerting Co., Philadelphia, Pa.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.

GOVERNORS (PUMP)
Atlas Valve Co., Newark, N. J.
Bishop & Babcock Sales Co., Cleveland, Ohio.
Crane Co., Chicago, Ill.
Kieley & Mueller, Inc., New York.
Marsh & Co., Jas. P., Chicago, Ill.
Watts Regulator Co., Lawrence, Mass.
Webster & Co., Warren, Camden, N. J.

GRATES, DUMPING
Fitzgibbons Boiler Co., Inc., New York.
Kewanee Boiler Corp., Kewanee, Ill.
Stanwood Corp., Cincinnati, Ohio.

GRATES, ROCKING
Kewanee Boiler Corp., Kewanee, Ill.
Stanwood Corp., Cincinnati, Ohio.

GRATES, SHAKING
Fitzgibbons Boiler Co., Inc., New York.
Kewanee Boiler Corp., Kewanee, Ill.
Stanwood Corp., Cincinnati, Ohio.

GRATES, SHAKING AND DUMPING
Frost Mfg. Co., Galesburg, Ill.
Kewanee Boiler Corp., Kewanee, Ill.
Stanwood Corp., Cincinnati, Ohio.

GRATES, SHAKING, CIRCULAR
Fitzgibbons Boiler Co., Inc., New York.

GRATES, STATIONARY
Fitzgibbons Boiler Co., Inc., New York.
Frost Mfg. Co., Galesburg, Ill.
Stanwood Corp., Cincinnati, Ohio.

HEAT CABINETS
(See Radiators, Cabinet and Concealed)

HEATERS, AIR, FAN SYSTEM
Aerofin Corp., Newark, N. J.
American Blower Co., Detroit, Mich.
Bayley Blower Co., Milwaukee, Wis.
Bishop & Babcock Sales Co., Cleveland, Ohio.
Buffalo Forge Co., Buffalo, N. Y.
Modine Mfg. Co., Racine, Wis.
New York Blower Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.
Trane Co., La Crosse, Wis.
Wing Mfg. Co., L. J., New York.
Young Radiator Co., Racine, Wis.

HEATERS, DOMESTIC WATER
Alberger Heater Co., Buffalo, N. Y.
American Radiator Co., New York, N. Y.
Crane Co., Chicago, Ill.
Davis Engineering Corp., New York.
Frank Heater & Engineering Co., O. E. Buffalo, N. Y.
Illinois Malleable Iron Co., Chicago, Ill.
Kewanee Boiler Corp., Kewanee, Ill.
McDermott Water Heaters, Inc., New York, N. Y.
Modine Mfg. Co., Racine, Wis.
Monitor Boiler Co., Philadelphia, Pa.
Patterson-Kelley Co., New York.
Ross Heater & Mfg. Co., Buffalo, N. Y.
The Stack Heater Co., Boston, Mass.
Weil-McLain Co., Chicago, Ill.
Whitlock Coil Pipe Co., Hartford, Conn.

HEATERS, FEED WATER, (CLOSED)
Alberger Heater Co., Buffalo, N. Y.
Davis Engineering Corp., New York.
Frank Heater & Engineering Co., O. E. Buffalo, N. Y.
Frost Mfg. Co., Galesburg, Ill.
Illinois Malleable Iron Co., Chicago, Ill.
Patterson-Kelley Co., New York.
Ross Heater & Mfg. Co., Buffalo, N. Y.
Schutte & Koerting Co., Philadelphia, Pa.
Stanwood Corp., Cincinnati, Ohio.
The Stack Heater Co., Boston, Mass.
Watts Regulator Co., Lawrence, Mass.
Whitlock Coil Pipe Co., Hartford, Conn.

HEATERS, FEED WATER (OPEN)
Frost Mfg. Co., Galesburg, Ill.
Stanwood Corp., Cincinnati, Ohio.

HEATERS, FUEL-OIL
Alberger Heater Co., Buffalo, N. Y.
Davis Engineering Corp., New York.
Electrol, Inc., St. Louis, Mo.
Frank Heater & Engineering Co., O. E., Buffalo, N. Y.
Gar Wood Engineering Co., Detroit, Mich.
Patterson-Kelley Co., New York.
Ross Heater & Mfg. Co., Buffalo, N. Y.
Schutte & Koerting Co., Philadelphia, Pa.
The Stack Heater Co., Boston, Mass.
Whitlock Coil Pipe Co., Hartford, Conn.

HEATERS, UNIT
Bayley Blower Co., Milwaukee, Wis.
Bishop & Babcock Sales Co., Cleveland, Ohio.
Buffalo Forge Co., Buffalo, N. Y.
McQuay Radiator Corp., Chicago, Ill.
Modine Mfg. Co., Racine, Wis.
Nelson Corp., Herman, The, Moline, Ill.
New York Blower Co., Chicago, Ill.
Peerless Unit Ventilation Co., Inc., Bridgeport, Conn.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.
Trane Co., La Crosse, Wis.
Wing Mfg. Co., L. J., New York.
Wolverine Tube Co., Detroit, Mich.
Young Radiator Co., Racine, Wis.

HEATERS, UNIT GAS FIRED
General Gas Light Co., Kalamazoo, Mich.

HEATING SYSTEMS, GAS
Jas. B. Clow & Sons, Chicago, Ill.
Gar Wood Engineering Co., Detroit, Mich.

HEATING SYSTEMS, VACUUM
Barnes & Jones, Boston, Mass.
Bishop & Babcock Sales Co., Cleveland, Ohio.
Hoffman Specialty Co., New York.
Illinois Engineering Co., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Marsh & Co., Jas. P., Chicago, Ill.
Sarco Co., Inc., New York.
Sterling Engineering Co., Milwaukee, Wis.
Trane Co., La Crosse, Wis.
Webster & Co., Warren, Camden, N. J.

HEATING SYSTEMS, VAPOR
American District Steam Co., North Tonawanda, N. Y.
Barnes & Jones, Boston, Mass.
Bishop & Babcock Sales Co., Cleveland, O.
Hoffman Specialty Co., New York.
Illinois Engineering Co., Chicago, Ill.
Marsh & Co., Jas. P., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Sarco Co., Inc., New York.
Simplex Heating Specialty Co., Inc., Lynchburg, Va.
Sterling Engineering Co., Milwaukee, Wis.
Trane Co., La Crosse, Wis.
Vapor Engineering Co., New York.
Webster & Co., Warren, Camden, N. J.

HEATING SYSTEMS, WATER
American Radiator Co., New York, N. Y.
Bishop & Babcock Sales Co., Cleveland, Ohio.
Grinnell Co., Providence, R. I.
Hornung, J. C., Chicago, Ill.
Ross Heater & Mfg. Co., Buffalo, N. Y.
The Stack Heater Co., Boston, Mass.

HUMIDIFIERS
American Air Filters Co., Louisville, Ky.
Bayley Blower Co., Milwaukee, Wis.
Bishop & Babcock Sales Co., Cleveland, Ohio.
Buffalo Forge Co., Buffalo, N. Y.
Carrier Engineering Corp., Newark, N. J.
Grinnell Co., Providence, R. I.
Johnson Service Co., Milwaukee, Wis.
National Regulator Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.
Watts Regulator Co., Lawrence, Mass.
Woodward Co., Frank E., Boston, Mass.

HUMIDITY CONTROL
American Air Filter Co., Louisville, Ky.
Bayley Blower Co., Milwaukee, Wis.
Bishop & Babcock Sales Co., Cleveland, Ohio.
Carrier Engineering Corp., Newark, N. J.
Grinnell Co., Providence, R. I.
Johnson Service Co., Milwaukee, Wis.
National Regulator Co., Chicago, Ill.
Powers Regulator Co., Chicago, Ill.

INSTRUMENTS, ELECTRIC MEASURING
Bristol Co., The, Waterbury, Conn.

INSTRUMENTS, INDICATING AND RECORDING
Bristol Co., The, Waterbury, Conn.
Marsh & Co., Jas. P., Chicago, Ill.
Mercoid Corporation, Chicago, Ill.

INSULATION, BOILER, PIPE, ETC.
(See Covering, Boiler, Pipe, etc.)

INSULATION, BUILDING
Celotex Co., Chicago, Ill.
Flax-li-num Insulating Co., St. Paul, Minn.
General Insulating & Mfg. Co., Alexandria, Ind.
Insulite Co., Minneapolis, Minn.
Johns-Manville Corp., New York, N. Y.

KETTLES, COPPER
Badger & Sons Co., E. B., Boston, Mass.

MECHANICAL DRAFT APPLIANCES
(See Draft Appliances, Mechanical)

METALS, THERMOSTATIC
Chace Valve Co., W. M., Detroit, Mich.

METERS, CONDENSATION
Central Station Steam Co., Detroit, Mich.

METERS, FEED WATER
Central Station Steam Co., Detroit, Mich.

METERS, PITOT TUBE
Buffalo Forge Co., Buffalo, N. Y.

METERS, WATER, GAS, OIL & AIR
Pittsburgh Equitable Meter Co., Pittsburgh, Pa.

MOTORS (ELECTRIC)
Baldor Electric Co., St. Louis, Mo.
Century Electric Co., St. Louis, Mo.
Emerson Electric Mfg. Co., St. Louis, Mo.
Janette Mfg. Co., Chicago, Ill.
Ohio Electric Mfg. Co., Cleveland, O.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.

NOZZLES, SPRAY
Bayley Blower Co., Milwaukee, Wis.
Bishop & Babcock Sales Co., Cleveland, Ohio.
Buffalo Forge Co., Buffalo, N. Y.
Carrier Engineering Corp., Newark, N. J.
Schutte & Koerting Co., Philadelphia, Pa.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.

OIL BURNERS
Carborundum Co., Perth Amboy, N. J.
Century Engineering Co., Cedar Rapids, Ia.
Electrol Inc., St. Louis, Mo.
Johnson Co., S. T., Oakland, Cal.
Silent Automatic Corp., Detroit, Mich.

OIL BURNER EQUIPMENT
Buffalo Forge Co., Buffalo, N. Y.
Cook Electric Co., Chicago, Ill.
Hornung, J. C., Chicago, Ill.
Janette Mfg. Co., Chicago, Ill.
Johnston Bros., Inc., Ferrysburg, Mich.
Schutte & Koerting Co., Philadelphia, Pa.

OIL BURNER IGNITION AND CONTROL EQUIPMENT
McAlear Mfg. Co., Chicago, Ill.
McDonnell & Miller, Chicago, Ill.
Mercoid Corporation, Chicago, Ill.
Penn Electric Switch Co., Des Moines, Iowa.
Time-O-Stat Controls Co., Elkhart, Ind.
White Mfg. Co., St. Paul, Minn.

OZONE APPARATUS
United States Ozone Co. of America, Scottdale, Pa.

PIPE BENDING
Badger & Sons Co., E. B., Boston, Mass.
Crane Co., Chicago, Ill.
Grinnell Co., Providence, R. I.
Whitlock Coil Pipe Co., Hartford, Conn.

PIPE, CAST-IRON
American Radiator Co., New York.

PIPE HANGERS
Crane Co., Chicago, Ill.
Grinnell Co., Providence, R. I.

PIPE THREADING & CUTTING MACHINES
Crane Co., Chicago, Ill.

PIPE, STEEL
Crane Co., Chicago, Ill.
National Tube Co., Pittsburgh, Pa.

PRESSURE REDUCING VALVES
(See Regulators, Pressure).

PUMPS, CENTRIFUGAL
American Steam Pump Co., Battle Creek, Mich.
Chicago Pump Co., Chicago, Ill.
Nash Engineering Co., So. Norwalk, Ct.
Trane Co., La Crosse, Wis.

PUMPS, CENTRIFUGAL, VACUUM HEATING
American Steam Pump Co., Battle Creek, Mich.
Ames Pump Co., New York.
Chicago Pump Co., Chicago, Ill.
Nash Engineering Co., So. Norwalk, Ct.
Skidmore Corp., Chicago, Ill.
Trane Co., La Crosse, Wis.

PUMPS, CONDENSATION
American Steam Pump Co., Battle Creek, Mich.
Ames Pump Co., New York.
Chicago Pump Co., Chicago, Ill.
Decatur Pump Co., Decatur, Ill.
Nash Engineering Co., So. Norwalk, Ct.
Skidmore Corp., Chicago, Ill.
Sterling Engineering Co., Milwaukee, Wis.
Trane Co., La Crosse, Wis.

PUMPS, OIL
Janette Mfg. Co., Chicago, Ill.

PUMPS, SUMP
American Steam Pump Co., Battle Creek, Mich.
Chicago Pump Co., Chicago, Ill.
Janette Mfg. Co., Chicago, Ill.
Nash Engineering Co., So. Norwalk, Ct.

PUMPS, TURBINE
Ames Pump Co., New York.
Decatur Pump Co., Decatur, Ill.
Nash Engineering Co., So. Norwalk, Ct.

PUMPS, VACUUM
Amernican Steam Pump Co., Battle Creek, Mich.
Ames Pump Co., New York.
Chicago Pump Co., Chicago, Ill.
Janette Mfg. Co., Chicago, Ill.
Nash Engineering Co., So. Norwalk, Ct.
Skidmore Corp., Chicago, Ill.

RADIATION, LIGHT WEIGHT, NON FERROUS
American Radiator Co., New York.
McQuay Radiator Co., Chicago, Ill.
The Herman Nelson Corp., Moline, Ill.
Rome Brass Radiator Corp., New York.
Trane Co., La Crosse, Wis.
Winchester Repeating Arms Co., New Haven, Conn.
Young Radiator Co., Racine, Wis.

RADIATOR ENCLOSURES AND SHIELDS
McQuay Radiator Corp., Chicago, Ill.

RADIATOR HANGERS
American Radiator Co., New York, N. Y.
Grinnell Co., Providence, R. I.
Hartmann Co., Charles, Brooklyn, N. Y.
Healy-Ruff Co., St. Paul, Minn.
Kewanee Boiler Corp., Kewanee, Ill.
McAlear Mfg. Co., Chicago, Ill.

RADIATOR TUBES, COPPER
Wolverine Tube Co., Detroit, Mich.

RADIATORS, CABINET AND CONCEALED
Fintube Radiator Co., Long Island City, N. Y.
McQuay Radiator Corp., Chicago, Ill.
Modine Mfg. Co., Racine, Wis.
Nelson Corp., Herman, The, Moline, Ill.
Rome Brass Radiator Corp., New York.
Trane Co., La Crosse, Wis.
Young Radiator Co., Racine, Wis.

RADIATORS, CAST-IRON
American Radiator Co., New York, N. Y.
Burnham Boiler Corp., Irvington, N. Y.
Crane Co., Chicago, Ill.
Kewanee Boiler Corp., Kewanee, Ill.
Modine Mfg. Co., Racine, Wis.
Nelson Corp., Herman, The, Moline, Ill.

RADIATORS, GAS-FIRED
American Radiator Co., New York, N. Y.
Jas. B. Clow & Sons, Chicago, Ill.

RADIATORS, VERTICAL FIN
Wolverine Tube Co., Detroit, Mich.

RECEIVERS, AIR
Brownell Co., The, Dayton, Ohio.
Frost Mfg. Co., Galesburg, Ill.
Vapor Engineering Co., New York.
Whitlock Coil Pipe Co., Hartford, Conn.

RECEIVERS, CONDENSATION
Crane Co., Chicago, Ill.
Illinois Engineering Co., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
The Stack Heater Co., Boston, Mass.
Trane Co., La Crosse, Wis.
Vapor Engineering Co., New York.
Whitlock Coil Pipe Co., Hartford, Conn.

REGULATORS, BOILER-FEED
Atlas Valve Co., Newark, N. J.
Kieley & Mueller, Inc., New York.
McAlear Mfg. Co., Chicago, Ill.
McDonnell & Miller, Chicago, Ill.
The Stack Heater Co., Boston, Mass.
Watts Regulator Co., Lawrence, Mass.

REGULATORS, DAMPER
American Radiator Co., New York, N. Y.
Atlas Valve Co., Newark, N. J.
Hoffman Specialty Co., New York.
Illinois Engineering Co., Chicago, Ill.
Johnson Service Co., Milwaukee, Wis.
Kieley & Mueller, Inc., New York.
McAlear Mfg. Co., Chicago, Ill.
Marsh & Co., Jas. P., Chicago, Ill.
National Regulator Co., Chicago, Ill.
Powers Regulator Co., Chicago, Ill.
Sarco Co., Inc., New York.
Simplex Heating Specialty Co., Inc., Lynchburg, Va.
The Stack Heater Co., Boston, Mass.
Sterling Engineering Co., Milwaukee, Wis.
Trane Co., La Crosse, Wis.
Watts Regulator Co., Lawrence, Mass.
White Mfg. Co., St. Paul, Minn.

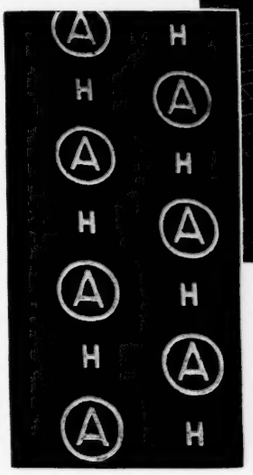
REGULATORS, GAS
Pittsburgh Equitable Meter Co., Pittsburgh, Pa.

REGULATORS, PRESSURE
Atlas Valve Co., Newark, N. J.
Bishop & Babcock Sales Co., Cleveland, Ohio.
Bristol Co., The, Waterbury, Conn.
Crane Co., Chicago, Ill.
Hornung, J. C., Chicago, Ill.
Illinois Engineering Co., Chicago, Ill.
Jenkins Bros., New York.

A WRENCH WON'T STOP VIBRATION

so he calls on CORK

Armstrong's Cork Machinery Isolation is installed under these machines in the Barclay-Vesey Telephone Building, New York Telephone Co., New York City.



You can't go wrong on Armstrong's Isolation: just watch for the Circle A.

THERE are certain things that can't be mended with tools. Machine vibration, for instance—the vibration that shortens the life of the machine unless checked. That's why cork-cushioning is so important.

With Armstrong's Cork Machinery Isolation, vibration and noise can be subdued in practically any moving machine. The weight, speed, and action of the machinery make no difference. Armstrong's Cork Machinery Isolation is made in three densities and seven thicknesses so the engineer can order the precise quality for the muffling of his machine.

Armstrong's Cork Machinery Isolation also protects nearby machinery. It strengthens the building structure against jarring. Promotes the efficiency and comfort of workers. Of special importance to hotels, apartment houses, and office buildings, it eliminates or greatly reduces the transmission of hum and vibration, preventing complaints from tenants.

Many special uses for Armstrong's Cork Machinery Isolation have introduced themselves. Its proved value in deadening jar and vibration has become valuable in the cork-cushioning of building structures, too.

Have you problems of noise and vibration? In factory, office building, hotel, hospital, or any other building? Then Armstrong engineers will gladly consult with you. Samples and data will also be sent on request. There is no obligation, of course. Armstrong Cork & Insulation Co., 925 Concord St., Lancaster, Pennsylvania.

Armstrong's (A) Product

Armstrong's Cork Machinery Isolation

Muffle These Machines

Armstrong's Cork Machinery Isolation is used for: air compressors, blowers, drill presses, drop hammers, elevator hoists, engines, fans, forging machines, machine tools, motors, motor generators, printing presses, pumps, punching machines, refrigerating machines, vacuum cleaners, and similar apparatus.

Johnson Service Co., Milwaukee, Wis.
Kainer & Company, Chicago, Ill.
Kieley & Mueller, Inc., New York.
Lytton Mfg. Corp., Franklin, Va.
McAlear Mfg. Co., Chicago, Ill.
Marsh & Co., Jas. P., Chicago, Ill.
National Regulator Co., Chicago, Ill.
Pittsburgh Equitable Meter Co., Pittsburgh, Pa.
Powers Regulator Co., Chicago, Ill.
Schutte & Koerting Co., Philadelphia, Pa.
The Stack Heater Co., Boston, Mass.
Watts Regulator Co., Lawrence, Mass.

REGULATORS, TEMPERATURE

(See Temperature Control)

REGULATOR, WATER

Pittsburgh Equitable Meter Co., Pittsburgh, Pa.

SEPARATORS, OIL

Bishop & Babcock Sales Co., Cleveland, Ohio.
Crane Co., Chicago, Ill.
Illniois Engineering Co., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Patterson-Kelley Co., New York.
Schutte & Koerting Co., Philadelphia, Pa.
Webster & Co., Warren, Camden, N. J.

SEPARATORS, STEAM

Bishop & Babcock Sales Co., Cleveland, Ohio.
Crane Co., Chicago, Ill.
Illinois Engineering Co., Chicago, Ill.
Webster & Co., Warren, Camden, N. J.

SPRAY COOLING SYSTEMS

Bayley Blower Co., Milwaukee, Wis.
Bishop & Babcock Sales Co., Cleveland, Ohio.
Buffalo Forge Co., Buffalo, N. Y.
Schutte & Koerting Co., Philadelphia, Pa.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.

SPRAY NOZZLES

(See Nozzles, Spray)

STERILIZER, WATER

U. S. Ozone Corp., Scottdale, Penn.

STOKERS, MECHANICAL

Brownell Co., Dayton, Ohio.
Detroit Stoker Co., Detroit, Mich.
Domestic Stoker Co., New York.
Whiting Corp., Harvey, Ill.

STRAINERS, OIL

Bishop & Babcock Sales Co., Cleveland, Ohio.
Illinois Engineering Co., Chicago, Ill.
Janette Mfg. Co., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Pittsburgh Equitable Meter Co., Pittsburgh, Pa.
Sarco Co., Inc., New York.
Schutte & Koerting Co., Philadelphia, Pa.

STRAINERS, STEAM

Bishop & Babcock Sales Co., Cleveland, Ohio.
Illinois Engineering Co., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Sarco Co., Inc., New York.
Schutte & Koerting Co., Philadelphia, Pa.

STRAINERS, WATER

Illinois Engineering Co., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Pittsburgh Equitable Meter Co., Pittsburgh, Pa.
Ross Heater & Mfg. Co., Buffalo, N. Y.
Sarco Co., Inc., New York.
Schutte & Koerting Co., Philadelphia, Pa.
Watts Regulator Co., Lawrence, Mass.

TANKS, COPPER

Badger & Sons Co., E. B., Boston, Mass.

TEMPERATURE CONTROL

American Radiator Co., New York, N. Y.
Atlas Valve Co., Newark, N. J.
Bishop & Babcock Sales Co., Cleveland, Ohio.
Bristol Co., The, Waterbury, Conn.
Carrier Engineering Corp., Newark, N. J.
Fulton Sylphon Co., Knoxville, Tenn.
Hornung, J. C., Chicago, Ill.
Illinois Engineering Co., Chicago, Ill.
Johnson Service Co., Milwaukee, Wis.
Kieley & Mueller, Inc., New York.
Marsh & Co., Jas. P., Chicago, Ill.
Mercoid Corporation, Chicago, Ill.
Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
National Regulator Co., Chicago, Ill.
Powers Regulator Co., Chicago, Ill.
Penn Electric Switch Co., Des Moines, Iowa.
Raymond, F. I., Chicago, Ill.
Sarco Co., Inc., New York.
The Stack Heater Co., Boston, Mass.
Stat-Amatic Instrument & Appliance Co., Hartford, Conn.
Sterling Engineering Co., Milwaukee, Wis.
Time-O-Stat Controls Co., Elkhart, Ind.
Trane Co., La Crosse, Wis.
Watts Regulator Co., Lawrence, Mass.
White Mfg. Co., St. Paul, Minn.

THERMOMETERS, RECORDING AND INDICATING

American Radiator Co., New York, N. Y.
Bristol Co., The, Waterbury, Conn.
Marsh & Co., Jas. P., Chicago, Ill.
Powers Regulator Co., Chicago, Ill.

THERMOSTATIC METAL

W. M. Chace Valve Co., Detroit, Mich.

THERMOSTATS

Bishop & Babcock Sales Co., Cleveland, Ohio.
Bristol Co., The, Waterbury, Conn.
Johnson Service Co., Milwaukee, Wis.
Marsh & Co., Jas. P., Chicago, Ill.
Mercoid Corporation, Chicago, Ill.
Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Modine Mfg. Co., Racine, Wis.
National Regulator Co., Chicago, Ill.
Powers Regulator Co., Chicago, Ill.
Sarco Co., Inc., New York.
Stat-Amatic Instrument & Appliance Co., Hartford, Conn.
Time-O-Stat Controls Co., Elkhart, Ind.
White Mfg. Co., St. Paul, Minn.

TRAPS, BUCKET

Crane Co., Chicago, Ill.
Marsh & Co., Jas. P., Chicago, Ill.

TRAPS, FLOAT

Crane Co., Chicago, Ill.
Marsh & Co., Jas. P., Chicago, Ill.
Sarco Co., Inc., New York.

TRAPS, FLOAT & THERMOSTATIC

Marsh & Co., Jas. P., Chicago, Ill.
Sarco Co., Inc., New York, N. Y.

TRAPS, INVERTED BUCKET (STEAM AND AIR)

Armstrong Machine Wks., Three Rivers, Mich.

TRAPS, LIFTING

Crane Co., Chicago, Ill.
Lytton Mfg. Corp., Franklin, Va.

TRAPS, RADIATOR

Armstrong Machine Wks., Three Rivers, Mich.
Barnes & Jones, Boston, Mass.
Bishop & Babcock Sales Co., Cleveland, Ohio.
Crane Co., Chicago, Ill.
Hoffman Specialty Co., New York.
Illinois Engineering Co., Chicago, Ill.
Jenkins Bros., New York.
Johns-Manville Corp., New York, N. Y.
Marsh & Co., Jas. P., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Sarco Co., Inc., New York.
Sterling Engineering Co., Milwaukee, Wis.
Trane Co., La Crosse, Wis.
Vapor Engineering Co., New York City.
Webster & Co., Warren, Camden, N. J.

TRAPS, RETURN

Bishop & Babcock Sales Co., Cleveland, Ohio.
Crane Co., Chicago, Ill.
Illinois Engineering Co., Chicago, Ill.
Johns-Manville Corp., New York, N. Y.
Kieley & Mueller, Inc., New York.
Lytton Mfg. Corp., Franklin, Va.
Marsh & Co., Jas. P., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Sarco Co., Inc., New York.
Simplex Heating Specialty Co., Inc., Lynchburg, Va.
Sterling Engineering Co., Milwaukee, Wis.
Trane Co., La Crosse, Wis.
Webster & Co., Warren, Camden, N. J.

TRAPS, STEAM

Barnes & Jones, Boston, Mass.
Bishop & Babcock Sales Co., Cleveland, Ohio.
Crane Co., Chicago, Ill.
Davis Engineering Corp., New York.
Hoffman Specialty Co., New York.
Illinois Engineering Co., Chicago, Ill.
Johns-Manville Corp., New York, N. Y.
Kieley & Mueller, Inc., New York.
Lytton Mfg. Corp., Franklin, Va.
Marsh & Co., Jas. P., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Powers Regulator Co., Chicago, Ill.
Sarco Co., Inc., New York.

TRAPS, VACUUM

Barnes & Jones, Boston, Mass.
Bishop & Babcock Sales Co., Cleveland, Ohio.
Crane Co., Chicago, Ill.
Hoffman Specialty Co., New York.
Illinois Engineering Co., Chicago, Ill.
Lytton Mfg. Corp., Franklin, Va.
Marsh & Co., Jas. P., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Sarco Co., Inc., New York.
Schutte & Koerting Co., Philadelphia, Pa.
Sterling Engineering Co., Milwaukee, Wis.
Trane Co., La Crosse, Wis.
Webster & Co., Warren, Camden, N. J.

TUBING, COPPER AND BRASS

Crane Co., Chicago, Ill.

TUBING, SEAMLESS, COPPER, BRASS AND ALUMINUM

Wolverine Tube Co., Detroit, Mich.

TURBINES, STEAM

Sturtevant Co., B. F., Hyde Park, Boston, Mass.
Wing Mfg. Co., L. J., New York.

TURBO-BLOWERS

Bayley Blower Co., Milwaukee, Wis.
Buffalo Forge Co., Buffalo, N. Y.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.
Wing Mfg. Co., L. J., New York.

UNIT HEATERS

(See Heaters, Unit)

VACUUM CLEANING APPARATUS

American Radiator Co., New York, N. Y.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.

VALVES, ACID RESISTING

Crane Co., Chicago, Ill.

VALVES, AIR, AUTOMATIC

American Radiator Co., New York, N. Y.
Bishop & Babcock Sales Co., Cleveland, Ohio.
Crane Co., Chicago, Ill.
Fulton Sylphon Co., Knoxville, Tenn.
Hoffman Specialty Co., New York.
Jenkins Bros., New York.
Marsh & Co., Jas. P., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
National Regulator Co., Chicago, Ill.
Powers Regulator Co., Chicago, Ill.

VALVES, AIR RELIEF

American Radiator Co., New York. N. Y.
Barnes & Jones, Boston, Mass.
Bishop & Babcock Sales Co., Cleveland, Ohio.
Crane Co., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Marsh & Co., Jas. P., Chicago, Ill.
Pittsburgh Equitable Meter Co., Pittsburgh, Pa.
Sarco Co., Inc., New York.
The Stack Heater Co., Boston, Mass.
Trane Co., La Crosse, Wis.

VALVES, BACK PRESSURE

Crane Co., Chicago, Ill.
Illinois Engineering Co., Chicago, Ill.
Illinois Malleable Iron Co., Chicago, Ill.
Jenkins Bros., New York.
Kieley & Mueller, Inc., New York.
McAlear Mfg. Co., Chicago, Ill.
Pittsburgh Equitable Meter Co., Pittsburgh, Pa.
Schutte & Koerting Co., Philadelphia, Pa.

VALVES, BALANCED

Crane Co., Chicago, Ill.
Illinois Engineering Co., Chicago, Ill.
Jenkins Bros., New York.
Kieley & Mueller, Inc., New York.
McAlear Mfg. Co., Chicago, Ill.
Powers Regulator Co., Chicago, Ill.
Schutte & Koerting Co., Philadelphia, Pa.
Watts Regulator Co., Lawrence, Mass.

VALVES, BLOW-OFF

Crane Co., Chicago, Ill.
Jenkins Bros., New York.
Lytton Mfg. Corp., Franklin, Va.
Pittsburgh Equitable Meter Co., Pittsburgh, Pa.

VALVES, CHECK

Crane Co., Chicago, Ill.
Grinnell Co., Providence, R. I.
Illinois Malleable Iron Co., Chicago, Ill.
Jenkins Bros., New York.
Schutte & Koerting Co., Philadelphia, Pa.

VALVES, DIFFERENTIAL RELIEF, GAS

Pittsburgh Equitable Meter Co., Pittsburgh, Pa.

VALVES, FLOAT

Atlas Valve Co., Newark, N. J.
Crane Co., Chicago, Ill.
Grinnell Co., Providence, R. I.
Illinois Engineering Co., Chicago, Ill.
Kieley & Mueller, Inc., New York.
McAlear Mfg. Co., Chicago, Ill.
Marsh & Co., Jas. P., Chicago, Ill.
Schutte & Koerting Co., Philadelphia, Pa.
Time-O-Stat Controls Co., Elkhart, Ind.
Watts Regulator Co., Lawrence, Mass.

VALVES, GATE

Crane Co., Chicago, Ill.
Grinnell Co., Providence, R. I.
Illinois Malleable Iron Co., Chicago, Ill.
Jenkins Bros., New York.
Marsh Valve Co., Dunkirk, N. Y.

VALVES, GLOBE, ANGLE & CROSS

Crane Co., Chicago, Ill.
Grinnell Co., Providence, R. I.
Illinois Malleable Iron Co., Chicago, Ill.
Jenkins Bros., New York.
Marsh Valve Co., Dunkirk, N. Y.
Powers Regulator Co., Chicago, Ill.
Schutte & Koerting Co., Philadelphia, Pa.

VALVES, HYDRAULIC-OPERATING

Crane Co., Chicago, Ill.
Jenkins Bros., New York.
Kieley & Mueller, Inc., New York.

VALVES, MAGNETIC

Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Time-O-Stat Controls Co., Elkhart, Ind.

VALVES, NON BY-PASS

The Stack Heater Co., Boston, Mass.

VALVES, NON-RETURN

Crane Co., Chicago, Ill.
Grinnell Co., Providence, R. I.
Illinois Engineering Co., Chicago, Ill.
Jenkins Bros., New York.
Kieley & Mueller, Inc., New York.
McAlear Mfg. Co., Chicago, Ill.

VALVES, RADIATOR

American Radiator Co., New York, N. Y.
Barnes & Jones, Boston, Mass.
Bishop & Babcock Sales Co., Cleveland, Ohio.
Crane Co., Chicago, Ill.
Hoffman Specialty Co., New York.
Illinois Engineering Co., Chicago, Ill.
Jenkins Bros., New York.
Marsh & Co., Jas. P., Chicago, Ill.
Marsh Valve Co., Dunkirk, N. Y.
National Regulator Co., Chicago, Ill.
Powers Regulator Co., Chicago, Ill.
Sarco Co., Inc., New York.
Simplex Heating Specialty Co., Inc., Lynchburg, Va.
Sterling Engineering Co., Milwaukee, Wis.
Trane Co., La Crosse, Wis.
Vapor Engineering Co., New York.
Webster & Co., Warren, Camden, N. J.

VALVES, PRESSURE REDUCING

(See Regulators, Pressure)

VALVES, REGULATING

Atlas Valve Co., Newark, N. J.
Bishop & Babcock Sales Co., Cleveland, Ohio.
Bristol Co., The, Waterbury, Conn.
Crane Co., Chicago, Ill.
Fulton Sylphon Co., Knoxville, Tenn.
Hornung, J. C., Chicago, Ill.
Illinois Engineering Co., Chicago, Ill.
Jenkins Bros., New York.
Kainer & Co., Chicago, Ill.
Kieley & Mueller, Inc., New York.
McAlear Mfg. Co., Chicago, Ill.
Powers Regulator Co., Chicago, Ill.
Sarco Co., Inc., New York.

VALVES, RELIEF (WATER)

Crane Co., Chicago, Ill.
Kainer & Co., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Marsh & Co., Jas. P., Chicago, Ill.
The Stack Heater Co., Boston, Mass.

VALVES, SAFETY

American Radiator Co., New York, N. Y.
Crane Co., Chicago, Ill.
Jenkins Bros., New York.
Marsh & Co., Jas. P., Chicago, Ill.
Pittsburgh Equitable Meter Co., Pittsburgh, Pa.
The Stack Heater Co., Boston, Mass.
Time-O-Stat Controls Co., Elkhart, Ind.

VALVES, STOP AND CHECK

(See Valves, Non-Return)

VALVES, VACUUM RELIEF

The Stack Heater Co., Boston, Mass.
Watts Regulator Co., Lawrence, Mass.

VENTILATING SYSTEMS

American Blower Co., Detroit, Mich.
American Radiator Co., New York, N. Y.
Bayley Blower Co., Milwaukee, Wis.
Bishop & Babcock Sales Co., Cleveland, Ohio.
Buffalo Forge Co., Buffalo, N. Y.
Carrier Engineering Corp., Newark, N. J.
National Regulator Co., Chicago, Ill.
Nelson Corp., Herman, The, Moline, Ill.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.
Wing Mfg. Co., L. J., New York.

VENTILATORS

Bayley Blower Co., Milwaukee, Wis.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.

VENTILATORS, FLOOR

Aeolus Dickinson, Chicago, Ill.
Buffalo Forge Co., Buffalo, N. Y.
Knowles Mushroom Ventilator Co., New York.
Ventilating Products Co., Chicago, Ill.

VENTILATORS, ROOF

Aeolus Dickinson, Chicago, Ill.

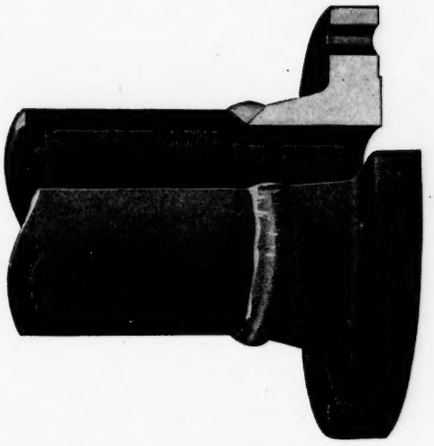
VENTILATORS, UNIT

Nelson Corp., Herman, The, Moline, Ill.
Peerless Unit Ventilation Co., Inc., Bridgeport, Conn.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.

ZONE HEATING SYSTEMS

Illinois Engineering Co., Chicago, Ill.
Marsh & Co., Jas. P., Chicago, Ill.

1855 • SEVENTY-FIFTH ANNIVERSARY • 1930



The specially designed welding neck permits a perfect union in a welded line.

SERIES 15

Crane forged steel flange with welding neck, No. 508 for pressures from 300 pounds atmospheric to 150 pounds at 500°.

SERIES 30

Crane forged steel flange with welding neck, No. 206E for pressures from 500 pounds atmospheric to 300 pounds at 750°.

For economy—for strength steel flanges with welding necks

The last few years have wrought many improvements in welding. Improvements in technique which make it more practical . . . in processes which make it as strong or stronger than the metal itself.

Crane Co. has followed these developments carefully, and has applied them to piping equipment, by manufacturing a complete line of forged steel flanges with welding necks.

These flanges provide for joints that are absolutely leak-proof and that offer high safety factors. Equally important, they institute genuine economies. Often they do away with the need for special valves and fittings; as on lines equipped with them regular stock valves can be used in absolute assurance of efficiency.

These welding flanges are made in sizes from 2 inches up, for steam working pressures as high as 300 pounds. Full information concerning them and the economies they will bring you can be had by writing Crane Co.

Valves CRANE *Fittings*

CRANE CO., GENERAL OFFICES: 836 S. MICHIGAN AVE., CHICAGO

NEW YORK OFFICES: 23 WEST 44TH STREET

Branches and Sales Offices in One Hundred and Ninety-six Cities

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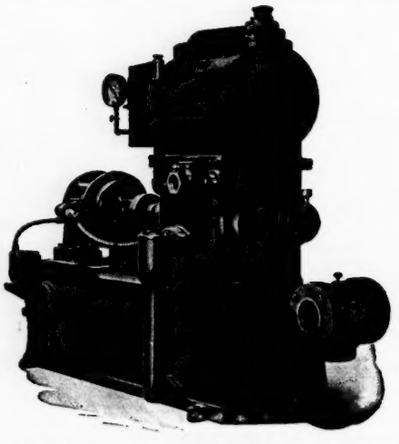
SKIDMORE VACUUM PUMPS



Skidmore Automatic Vacuum Pump

Insure

Entire Pump Satisfaction

The SKIDMORE VACUUM PUMP embodies all the features which stand for perfect pump design. Large air and water capacities, which remain constant because close clearances between moving parts have been eliminated and wear cannot destroy the efficiency of the unit — float control placed in tank base, giving lowest drainage by gravity—low power consumption—unit built of heavy cast iron and bronze fitted throughout—minimum floor space required.

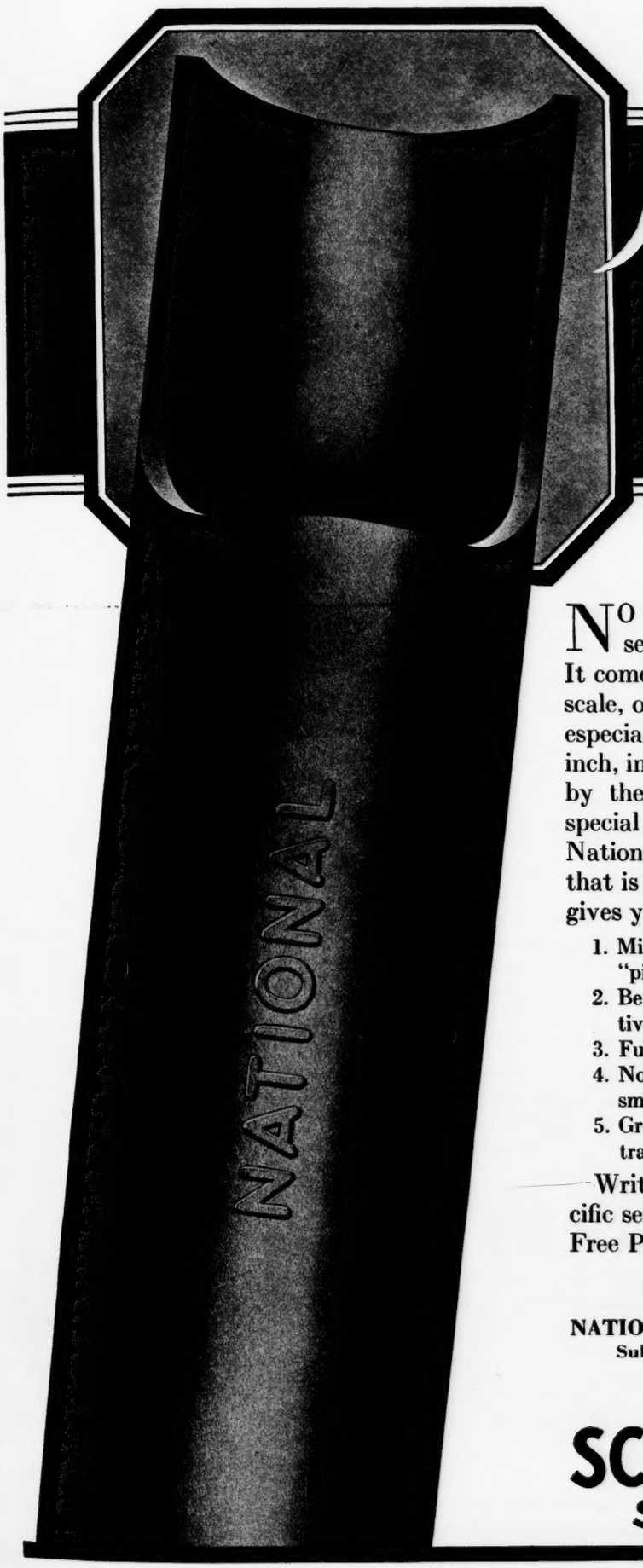
(*Write for Bulletin No. 6*)

SKIDMORE CORPORATION—CHICAGO

OFFICE AND FACTORY—1535 DAYTON STREET

REPRESENTATIVES IN PRINCIPAL CITIES

MADE AND SOLD IN CANADA BY DARLING BROS. LTD.—MONTREAL



Here's Pipe that's All Pipe NO SCALE

NO troublesome mill-scale to impair the service of NATIONAL Scale Free Pipe. It comes to you clean and smooth—free from scale, one of the principal causes of corrosion, especially pitting. All butt-weld sizes ½ to 3-inch, in addition to being Spellerized, are made by the NATIONAL Scale Free Process—a special process invented and developed by National Tube Company—to produce pipe that is *all* pipe and no scale. Scale Free Pipe gives you these five advantages—

1. Minimized corrosive tendencies, particularly "pitting"
2. Better base for galvanizing or other protective coatings.
3. Full delivery capacity—less friction loss.
4. No damage to valve seats; no clogging of small orifices.
5. Greater strength at the weld—due to the extra rolling in the process.

Write for Bulletin No. 7—describing specific service advantages of NATIONAL Scale Free Pipe—

America's Standard Wrought Pipe

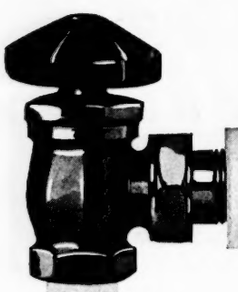
NATIONAL TUBE COMPANY · Pittsburgh, Pa.
Subsidiary of United States Steel Corporation

SCALE FREE PIPE
SPELLERIZED

MARSH

presents truly modern heating . . .

Marsh Weather Compensating System of heating



Advanced engineering skill and perfect mechanical equipment have produced the MARSH WEATHER COMPENSATING SYSTEM of heating—at once a system, a service and a warranty of reduced operating costs.

The MARSH WEATHER COMPENSATING SYSTEM of heating automatically meets the requirements of variable outside weather conditions with the greatest efficiency and economy. Specially designed compensating controls enable it to deliver only a sufficient quantity of heat to maintain a constant, comfortable temperature. A very great fuel saving is effected by placing the full demand upon the heating system *only* when its maximum output is needed. In spring, fall and winter, room temperatures remain constant.

A Guarantee of Economy

Installed in a new building, the cost of the MARSH WEATHER COMPENSATING SYSTEM of heating is approximately 4% to 6% above that of the standard return line vacuum system. Operating costs are so reduced that a return of from 50% to 100% on the additional investment is made each year. Installation in existing structures is equally simple and merely necessitates the replacement of certain of the old style valves and traps with modern, MARSH System Units.

The MARSH WEATHER COMPENSATING SYSTEM of heating pays for itself *out of savings*—THEN DIVIDENDS. Write for booklet.

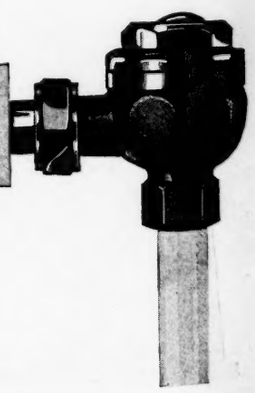
JAS. P. MARSH & CO.

(DIVISION OF COMMERCIAL INSTRUMENT CORPORATION)

Home Office: 2073 Southport Ave.
Chicago, Illinois

551 Fifth Ave., New York City Bendix Bldg., Los Angeles
2539 Pennsylvania Ave., N. W., Washington, D. C.
Other offices in principal cities

Marsh Weather Compensating System of Heating



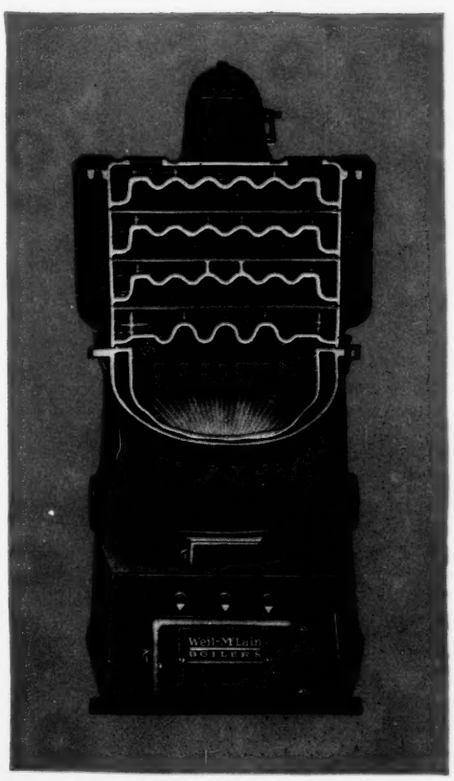
FAMOUS FIGHTERS

ATTILA

(King of the Huns)

"Attila the Hun" made himself complete master of Central Europe within the first eight years of his reign, which started in 433 A. D. The sound of his name brought fear to people outside of his empire but he was strongly supported by his own people. For the next twenty years he ruled all races from the Caspian to the Rhine. In 451, he led his many-nationed army over the Rhine and laid siege to the city of Orleans, which he later abandoned when a great Romano-Gothic army was seen on the horizon. The battle which followed was one of the great battles of the world. He next set out to conquer Italy, but he finally turned back at the entreaty of the Pope. Death came suddenly to Attila in 453, following a huge banquet in celebration of his wedding. He was never conquered.

Let Weil-McLain *fighting features* sell boilers for you



Exclusive features built into all Weil-McLain Boilers enable them to fight fuel waste and deliver more heat. These features are easily demonstrated to home owners. Because of this, they are good business builders and good boilers for you to handle.

Fuel-saving corrugations like this ∿∿∿

The Weil-McLain Round Boiler, for example, delivers more heat and saves fuel, because all the vital heat-absorbing surfaces are corrugated like this ∿∿∿ instead of flat like this ———. It is easy to show that the wavy line crowds 30 to 40 per cent more heating surface into the same space.

Balanced back-and-forth fire travel

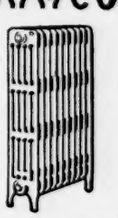
More heat is actually utilized in Weil-McLain Boilers because Weil-McLain fire travel is not only backward and forward, but it is *balanced*. Variations in the rate at which boilers operate, due to varying heat demands, do not alter the long, balanced, back-and-forth flow of gases through the flues.

In the complete line of Weil-McLain Boilers you will find scientific principles of design that enable these boilers to fight fuel waste and deliver more heat. The line includes Round Type, Jacketed, Square, Self-feed and Smokeless Boilers. Also Weil-McLain "Cameo" Radiators.

WEIL-McLAIN COMPANY, General Office: Chicago
Boiler Plant and Offices: Michigan City, Ind.
Radiator Plant and Offices: Erie, Pa.

Jobbing Distributors with local stocks in most jobbing centers

CAMEO



RADIATORS

Weil-McLain

SCIENTIFIC COMBUSTION

BOILERS

©1930, W.-McL.

fight fuel waste and deliver more heat

The How *and* Where . . . *of* profitable modernizing

"Where can I increase sales?" and "How shall I go about it?" Heating contractors asking themselves these questions will find the answer here.

Modernizing work is the key to this year's profits. That is why hundreds of contractors who clearly see the way the wind is blowing are enthusiastically signing up with Hoffman's Modernizing Sales Campaign. If offers a sturdy, simple merchandizing plan that drives a powerful wedge into every possible opening for business.

To the enterprising heating contractor using Hoffman's Sales Campaign, hundreds of homes become a rich source of sales—in profitable Hoffman-izing jobs. To him, every one-pipe steam system in his community is a ripe opportunity to land a valuable contract on a Hoffman No. 2 Vacuum Valve installation.

This sales campaign is a forceful, *localized* promoter of business. It enters hand-picked, selected homes where the new comfort and economy of Hoffman Vacuum Heating finds a ready market. *And makes a non-competitive, full-price sale.* Not only does this plan sell Hoffman Valves, but it paves the way to many sales of other merchandise and service.

Send today for full details of this productive merchandising idea. Hoffman Specialty Company, Inc., Dept. C-66, Waterbury, Conn.

VACUUM CHECK

Hoffman No. 2 Vacuum Valves are *double air-locked.* This exclusive, patented feature insures efficient operation whether radiator has been partially or fully heated.

Four simple changes enable you to offer the home owner a vacuum system that gives maximum comfort with minimum attention — and reduces fuel costs about $5 per radiator per year. (1) Install Hoffman No. 2 Valves on every radiator — (2) vent the mains with Hoffman No. 16 Valves—(3) tighten up the system to make it air-tight—(4) install a Hoffman Kompo Gauge on the boiler.

Not only do Hoffman Valves give you a larger profit but they protect your most priceless asset — *customer satisfaction.*

HOFFMAN SPECIALTY CO., INC.
Dept. C-66, Waterbury, Conn.

Please send me without obligation — full details of your special Business-Boosting Sales Campaign.

Name .....

Street .....

City ..... State .....